Brain-Based Learning

The wave of the brain

By Ruth Palombo Weiss

It's a jungle out there! We have all heard and probably uttered that phrase. Well, the Nobel Prize winning neurobiologist Gerald Edelman postulates that it's a jungle inside there as well. Edelman, director of the Neuroscience Institute at the Scripps Research Institute, compares our brains to a dense web of interconnecting synapses. His metaphor gives us insight into current, sometimes confusing, research on how the brain works and its connection to learning theory.

Many of us use the Internet daily and are astounded by the vast and seemingly endless connections we can make. The brain's interconnections exceed the Internet's by an astronomical number. The typical brain has approximately 100 billion neurons, and each neuron has one to 10,000 synaptic connections to other neurons. Says Edelman, "The intricacy and numerosity of brain connections are extraordinary."

Our brains are suffused with a vast number of interdependent networks. We process all incoming information through those networks, and any information already stored influences how and what we learn.

"The human brain is the best-organized, most functional three pounds of matter in the known universe," says educator Robert Sylwester in his book, *A Celebration of Neurons: An Educator's Guide to the Human Brain*. "It's responsible for Beethoven's Ninth Symphony, computers, the Sistine Chapel, automobiles, the Second World War, *Hamlet*, apple pie, and a whole lot more."

Increasingly, educators such as Sylwester are relying on brain-based learning theory to take advantage of the growing body of evidence that neurologists are uncovering about how humans learn. He says, "To learn more about the brain, scientists had to discover how to perform intricate studies that would provide solid information on its most basic operations—the normal and abnormal actions of a single neuron, the synchronized actions of networks of neurons, and the factors that trigger neuronal activity."

It's clear that no two human brains are alike. Every nerve cell (neuron) serves as a relay station. Neurons not only receive signals from other cells, but they also process the signals and send them on to other cells across tiny gaps called synapses. Chemicals called neurotransmitters (there may be as many as 100) cause the signals to flow from one neuron to another. That electrochemical process is the basis of all human behavior. Every time we speak, move, or think, electrical and chemical communication are taking place between tens of thousands of neurons.

"As a nerve cell is stimulated by new experiences and exposure to incoming information from the senses, it grows branches called dendrites. Dendrites are the major receptive surface of the nerve cell. One nerve cell can receive input from as many as 20,000 other nerve cells. If you have 100 billion cells in your brain, think of the complexity! With use, you grow branches; with impoverishment, you lose them.

"The ability to change the structure and chemistry of the brain in response to the environment is what we call plasticity," says Marian Diamond, a neuroscientist and professor of neuroanatomy at the University of California at Berkeley.

The Gist

- ❑ The human brain's interconnections exceed the Internet's by an astronomical number.
- ❑ Educators are increasingly relying on brain-based learning theory.
- ❑ Imaging technologies such as MRIs are helping scientists understand memory, recall, and how the brain manages information and information overload.

As we might imagine, for a subject as vast and complicated as brain research and learning theory there are a variety of views. Some scientists feel that there are fundamental differences between learning and education. They insist that brain-based research on learning isn't the same as research done on education theory. They also note that many of the initial neurological inquiries into learning have been done on animals and that it's an iffy proposition to extrapolate from animals to humans.

But during the past 10 years, known as the Decade of the Brain, a number of scientists have been using new technologies such as Magnetic Resonance Imaging (MRI), Functional MRI (fMRI), and Positron Emission Topography (PET) scans. Those tests help scientists explore how human brains process memory, emotion, attention, patterning, and context—