

## Brain scientists offer medical educators tips on the neurobiology of learning

### The research

"One of the most exciting advances, as a result of optical imaging of the living brain, is the demonstration that there is growth, retraction, and modifying connectivity between neurons," said Friedlander. "We have also seen that the mature brain can generate new neurons, although, this research is so new that the functional implications of these new neurons and their potential contribution to learning and memory formation remain to be determined," he said.

### RECOMMENDATIONS:

**Repetition:** Medical curricula often employ compressed coverage over limited time frames of a great amount of material. Learning theory and the neurobiology of learning and memory suggest that going deeper is more likely to result in better retention and depth of understanding. With repetition, many components of the neural processes become more efficient, requiring less energy and leaving higher-order pathways available for additional cognitive processing. However, repetitions must be appropriately spaced. Addressing the same information using different sensory processes, such as seeing and hearing, enhances the learning process, potentially bringing more neural hardware to bear to process and store information.

**Reward and reinforcement:** Reward is a key component of learning at all stages of life. "The brain's intrinsic reward system – self-congratulations with the realization of success -- plays a major role in reinforcement of learned behaviors," Friedlander said. "An important factor is the realization that accomplishing an immediate goal and a successful step toward a future goal can be equally rewarding." In the case of medical students, there are considerable rewards ahead of them in addition to the more immediate rewards of the satisfaction of understanding medicine. The students who derive joy from learning as they proceed through their medical education may have a greater chance of using the brain's capacity to provide reward signals on an ongoing basis, facilitating their learning process.

**Visualization:** Visualization and mental rehearsal are real biological processes with associated patterned activation of neural circuitry in sensory, motor, executive, and decision-making pathways in the brain. Internally generated activity in the brain from thoughts, visualization, memories, and emotions should be able to contribute to the learning process.

**Active engagement:** There is considerable neurobiological evidence that functional changes in neural circuitry that are associated with learning occur best when the learner is actively engaged.. Learners' having multiple opportunities to assume the role of teacher also invoke neural motivation and reward pathways -- and another major

biological component of the learning process: stress. Doing is learning. And success at doing and learning builds confidence.

**Stress:** Although the consequences of stress are generally considered undesirable, there is evidence that the molecular signals associated with stress can enhance synaptic activity involved in the formation of memory. However, particularly high levels of stress can have opposite effects. The small, interactive teaching format may be judiciously employed to moderately engage the stress system.

**Fatigue:** Patterns of neuronal activity during sleep reinforce the day's events. Research suggests that it is important to have appropriate downtime between intense problem-solving sessions. Downtime permits consolidation away from the formal teaching process.

**Multitasking:** Multitasking is a distraction from learning, unless all of the tasks are relevant to the material being taught. The challenge is to integrate information from multiple sources, such as a lecture and a hand-held device.

**Individual learning styles:** Neural responses of different individuals vary, which is the rationale for embracing multiple learning styles to provide opportunities for all learners to be most effectively reached. See [http://www.oucom.ohiou.edu/fd/learning\\_style\\_inventories.htm](http://www.oucom.ohiou.edu/fd/learning_style_inventories.htm).

"By appealing not only to students' capacity to derive pleasure from learning about medicine but also to their intellectual capacity for understanding the rationale for the educational process selected ... real motivation can be engendered. ... They become more effective communicators and enhance their patients' success at learning the information they need for managing their own health and treatments as well."

###

Source: Excerpted from - "What Can Medical Education Learn From the Neurobiology of Learning?" by Michael J. Friedlander, PhD; Linda Andrews, MD; Elizabeth G. Armstrong, PhD; Carol Aschenbrenner, MD; Joseph S. Kass, MD; Paul Ogden, MD; Richard Schwartzstein, MD; and Thomas R. Viggiano, MD, MEd. *Academic Medicine*, Vol. 86, No. 4 / April 2011 [http://www.eurekalert.org/pub\\_releases/2011-03/vt-bso032911.php](http://www.eurekalert.org/pub_releases/2011-03/vt-bso032911.php)

**NOTE FROM STEVE:** Education should result in **positive** knowledge, skill and attitude **changes**. To make this practical, check yourself against the recommendations, discuss them with your colleagues & charges, identify at least one thing you'll try to do differently as a result – write it down, share it for accountability and grow! Repeat for your students...if you're doing it, they will follow. They're watching you!!!