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Lighting Up Molecular Players in Learning with Evanescent-Wave Microscopy[1]

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Unraveling the molecular processes that underlie learning remains one of the most intriguing, unresolved problems in science. Learning and memory formation are believed to reflect alterations in the connections among nerve cells. These alterations are driven in part by proteins that are secreted from the surface of nerve cells. The secreted proteins act locally to mediate changes in nerve cell connectivity. Molecular processes, such as protein secretion, that occur near the cell surface can be studied in living cells using a biophysical technique known as evanescent-wave microscopy. In this technique, proteins of interest such as the molecular players in learning are fluorescently labeled using genetic engineering, and then living cells containing the proteins are illuminated with evanescent excitation light. The evanescent excitation light decays exponentially in intensity with distance from the cell surface, causing fluorescently tagged proteins to "light up" as they move toward or are secreted from the cell surface. In addition, proteins become invisible as they move more than ∼300 nm away from the cell surface. In this talk, I will discuss both evanescent-wave microscopy and some recent insights that we have obtained using this technique into pivotal processes that underlie learning.

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