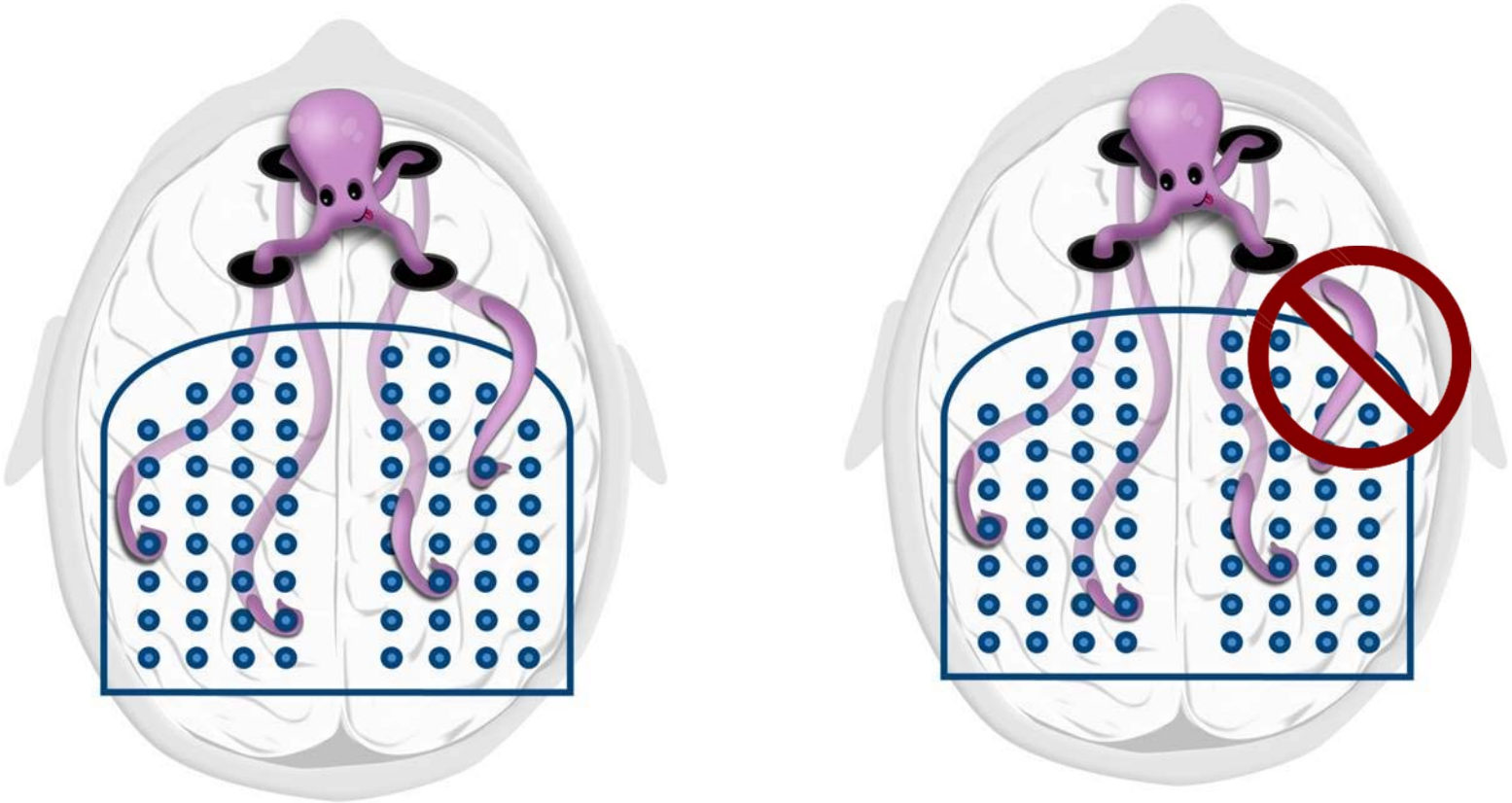
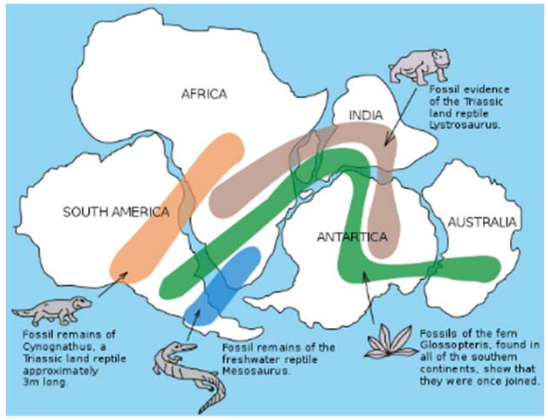
How to form a chunk – Part 2

By Barbara Oakley, PhD

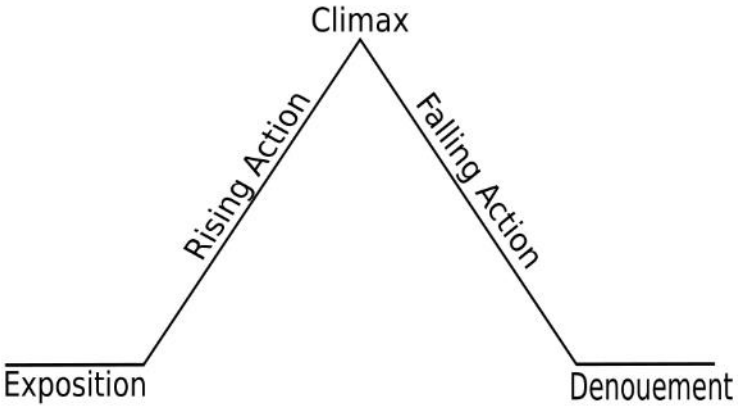
Group→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
↓Period																		
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	*	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	**	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Fl	115 Uup	116 Lv	117 Uus	118 Uuo
*				57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
**				89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

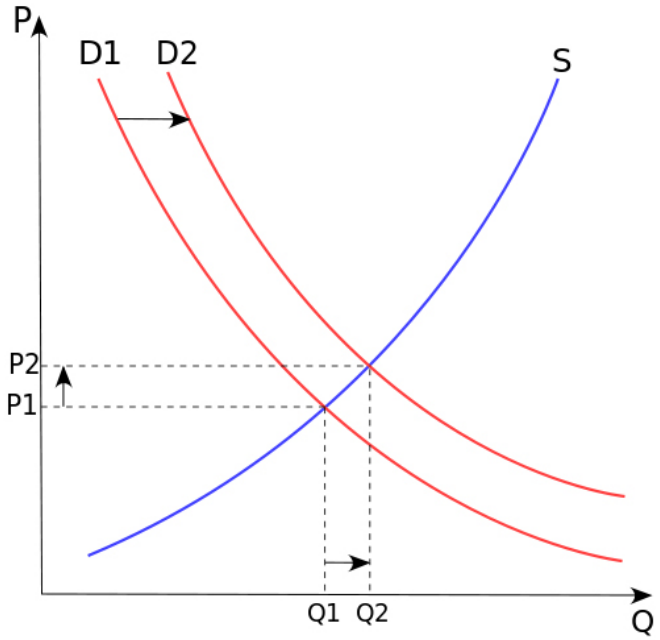


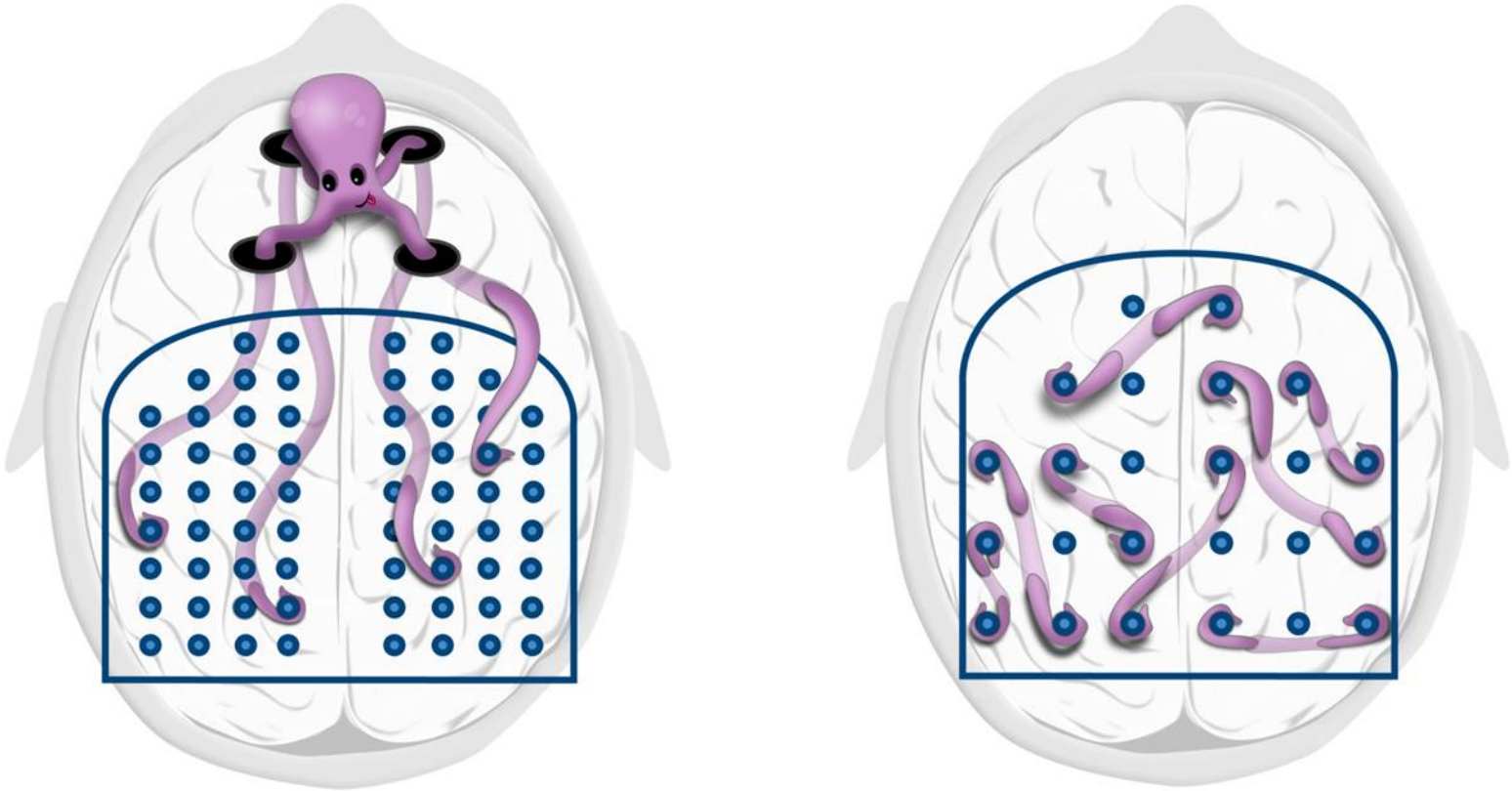
Understand

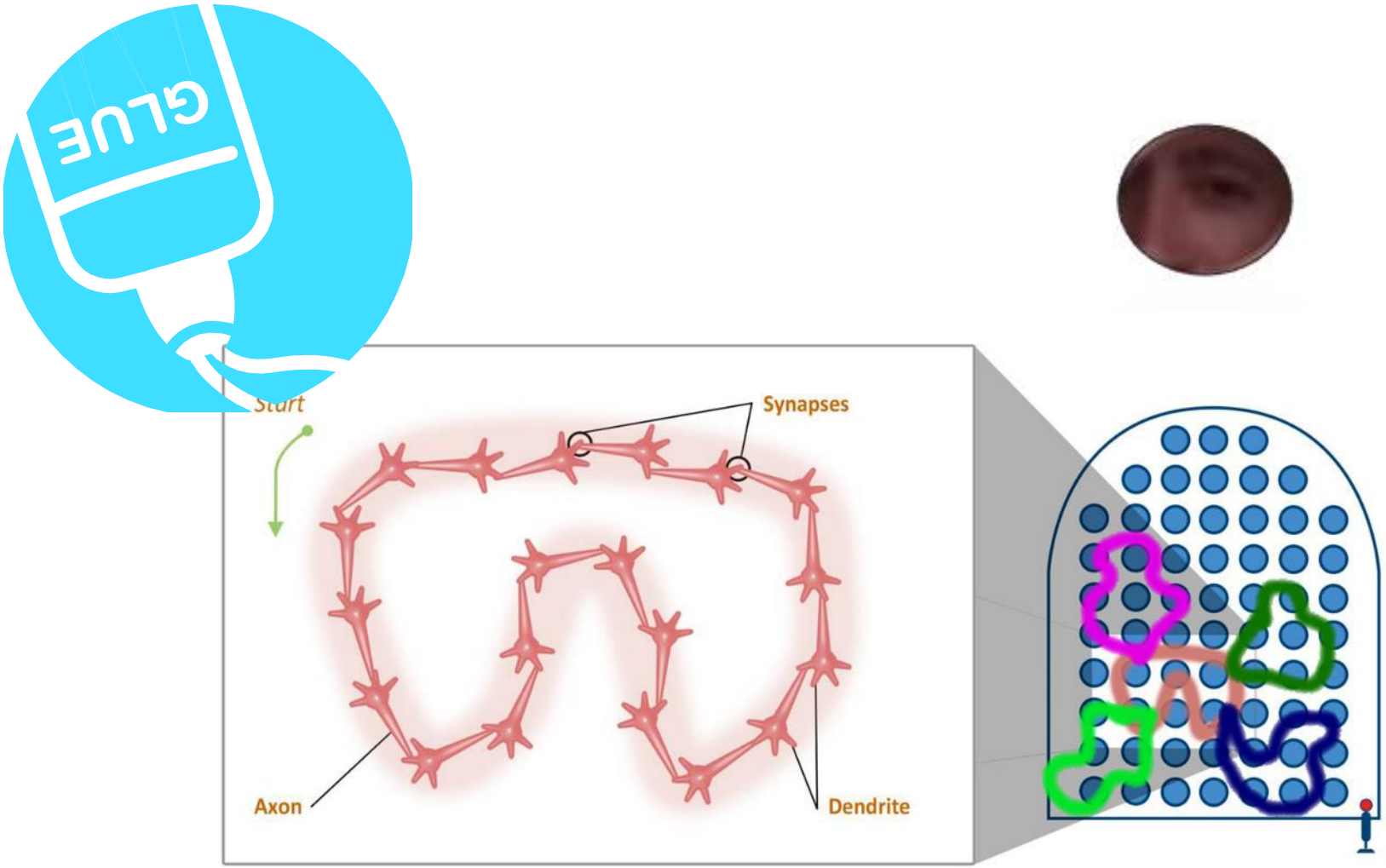


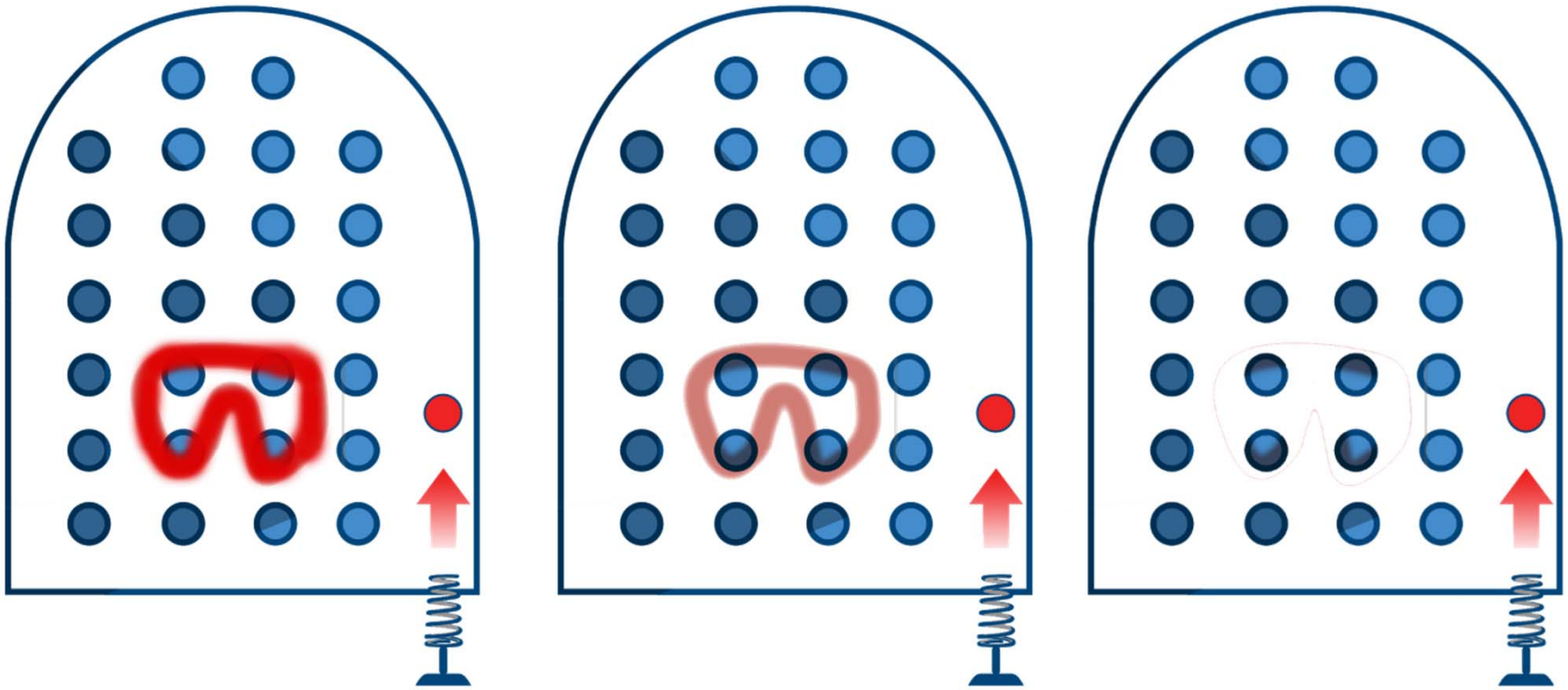
$$\operatorname{div}\mathbf{F} = \nabla \cdot \mathbf{F} = \frac{\partial U}{\partial x} + \frac{\partial V}{\partial y} + \frac{\partial W}{\partial z}.$$

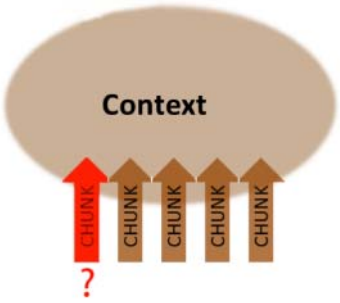




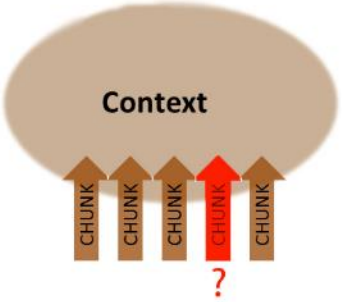



GLUE
Start
Synapses
Axon
Dendrite

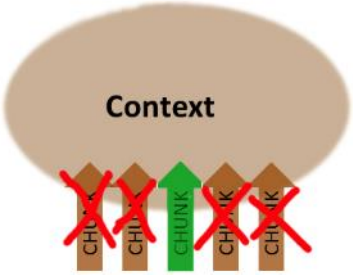




Bottom up learning (*chunking*)

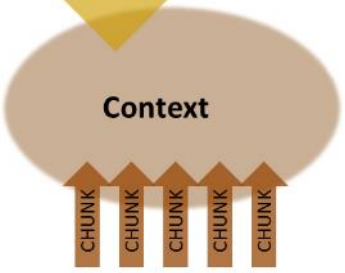


Bottom up learning (*chunking*)



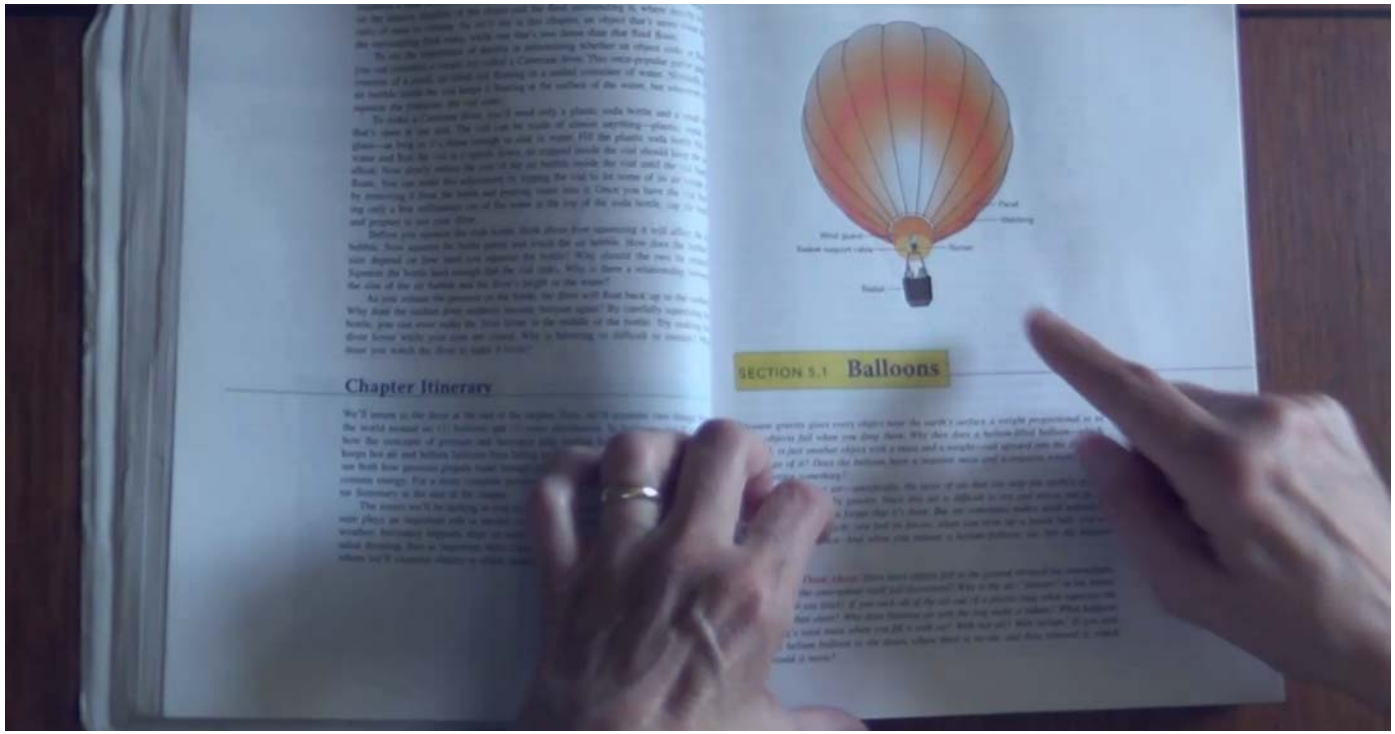
Bottom up learning (*chunking*)

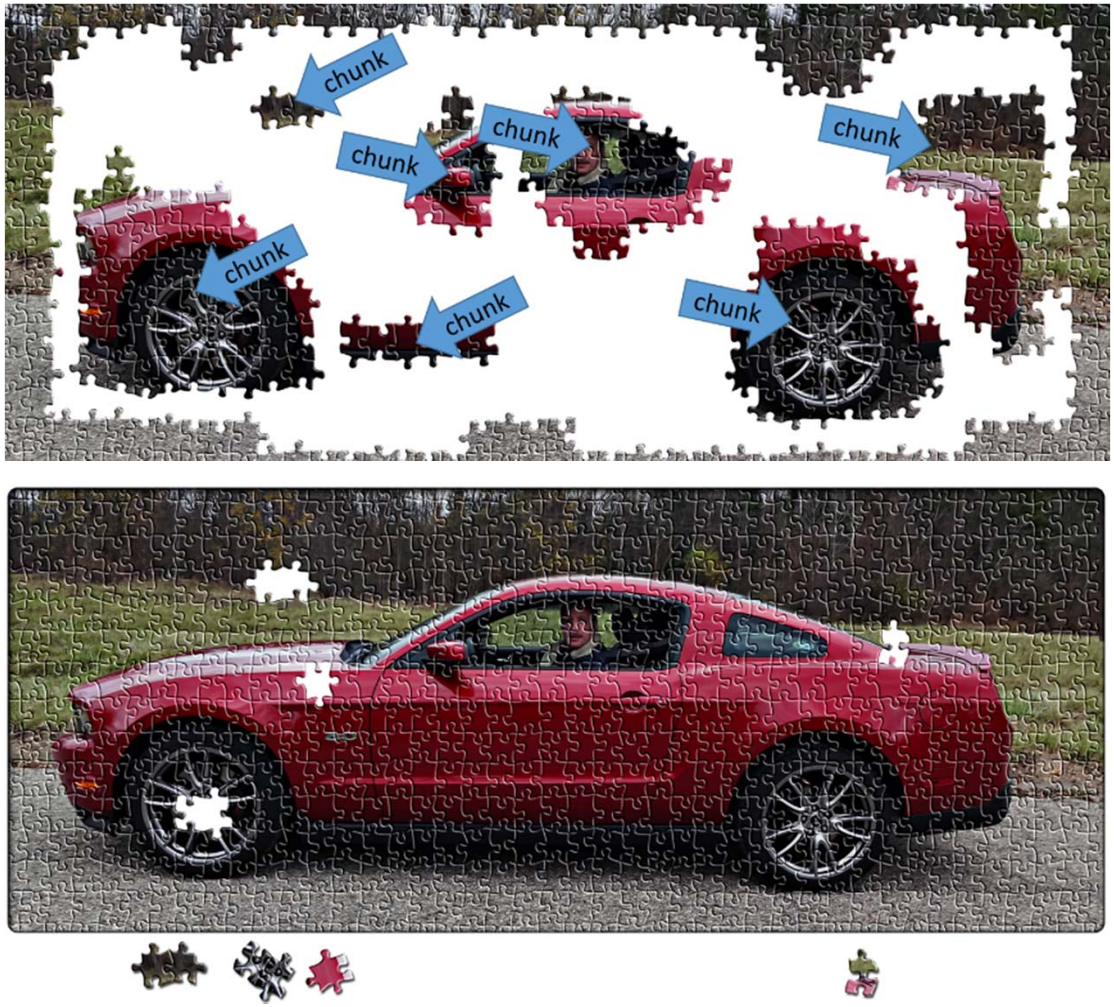
Top down learning (*big picture*)



Bottom up learning (*chunking*)

A “picture walk”




chunk
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- Focused attention
- Understanding
- Practice

Credits

- Artistic Rendering of the Library of Alexandria, based on some archaeological evidence. O. Von Corven - Tolzmann, Don Heinrich, Alfred Hessel and Reuben Peiss. The Memory of Mankind. New Castle, DE: Oak Knoll Press, 2001
- La karatéka croate Mirna Šenjug exécutant un kata aux championnats du monde de karaté seniors 2006, photo authored by Indrek Galetin, http://commons.wikimedia.org/wiki/File:%C5%A0enjug-kata-Tampere-2006.jpg
- Periodic table by DePiep. The colors represent different categories of elements.
- Supply and demand, Paweł Zdziarski (faxe), Astarot http://en.wikipedia.org/wiki/Supply_and_demand#mediaviewer/File:Supply-and-demand.svg
- "Freytag's pyramid," symbolizing his theory of dramatic structure, http://en.wikipedia.org/wiki/Dramatic_structure#mediaviewer/File:Freytags_pyramid.svg
- Fossil patterns across continents (Gondwanaland) by Osvaldocangaspadillahttp://en.wikipedia.org/wiki/Continental_drift#mediaviewer/File:Snider-Pellegrini_Wegener_fossil_map.svg
- Soprano aria from flyingpenguinsound, via pond5.com.
- Mona Lisa, by Leonardo da Vinci, from C2RMF retouche, http://en.wikipedia.org/wiki/Painting#mediaviewer/File:Mona_Lisa,_by_Leonardo_da_Vinci,_from_C2RMF_retouched.jpg
- The "picture walk" is through Louis Bloomfield's great textbook *How Things Work*.
- Puzzle of man in the car, ©Kevin Mendez and Philip Oakley, 2014.
- Octopus and tentacle pictures in focused and diffuse modes ©Kevin Mendez, 2014.
- Neurons firing together, ©Kevin Mendez, 2014.
- Top down versus bottom up ©Barbara Oakley, 2014.

Relevant Readings

- Brent, Rebecca, and Richard M. Felder. "Learning by Solving Solved Problems." *Chemical Engineering Education* 46, no. 1 (2012): 29-30.
- Cho, Soohyun, Arron W. S. Metcalfe, Christina B. Young, Srikanth Ryali, David C. Geary, and Vinod Menon. "Hippocampal-Prefrontal Engagement and Dynamic Causal Interactions in the Maturation of Children's Fact Retrieval." *Journal of Cognitive Neuroscience* 24, no. 9 (2012): 1849-66.
- Cooper, Graham, and John Sweller. "Effects of Schema Acquisition and Rule Automation on Mathematical Problem-Solving Transfer." *Journal of Educational Psychology* 79, no. 4 (1987): 347.
- Cree, George S, and Ken McRae. "Analyzing the Factors Underlying the Structure and Computation of the Meaning of Chipmunk, Cherry, Chisel, Cheese, and Cello (and Many Other Such Concrete Nouns)." *Journal of Experimental Psychology - General* 132, no. 2 (2003): 163-200.
- Gobet, F., and N. Charness, eds. *Chess and Games*. edited by K. Anders Ercisson, Neil Charness, Paul Feltovich and Robert R. Hoffman, Cambridge Handbook on Expertise and Expert Performance: Cambridge University Press, 2006.
- Gobet, F., and G. Clarkson. "Chunks in Expert Memory: Evidence for the Magical Number Four… or Is It Two?". *Memory* 12, no. 6 (2004): 732-47.
- Gobet, F., P.C.R. Lane, S. Croker, P.C.H. Cheng, G. Jones, I. Oliver, and J.M. Pine. "Chunking Mechanisms in Human Learning." *Trends in Cognitive Sciences* 5, no. 6 (2001): 236-43.
- Gobet, Fernand. "Chunking Models of Expertise: Implications for Education." *Applied Cognitive Psychology* 19, no. 2 (2005): 183-204.
- Guida, A., F. Gobet, H. Tardieu, and S. Nicolas. "How Chunks, Long-Term Working Memory and Templates Offer a Cognitive Explanation for Neuroimaging Data on Expertise Acquisition: A Two-Stage Framework." *Brain and Cognition* 79, no. 3 (Aug 2012): 221-44.
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- Nyhus, E., and T. Curran. "Functional Role of Gamma and Theta Oscillations in Episodic Memory." *Neuroscience and Biobehavioral Reviews* 34, no. 7 (Jun 2010): 1023-35.
- Rohrer, Doug, and Harold Pashler. "Recent Research on Human Learning Challenges Conventional Instructional Strategies." *Educational Researcher* 39, no. 5 (2010): 406-12.
- Sweller, John, Paul Ayres, and Slava Kalyuga. *Cognitive Load Theory*. NY: Springer, 2011.