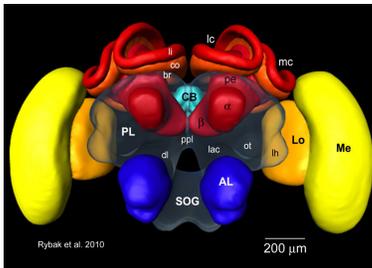


Social Insects' Brains



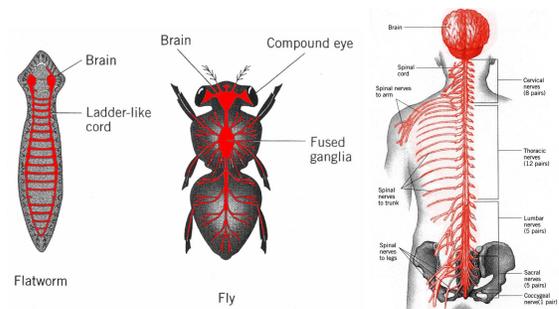
Wulfila Gronenberg
Department of Neuroscience

- Insect central nervous system
- Brains: input and output
- Brain composition and organization
- Brain size
- Brain Plasticity
-

What do you expect social insect brains to be like?

The central nervous system processes sensory input and controls motor output to generate the appropriate behavior.

Across animal phyla, central nervous systems are similarly organized
Derived from bilateral (ladder-like) chain of ganglia



Input to (social) insect brains:

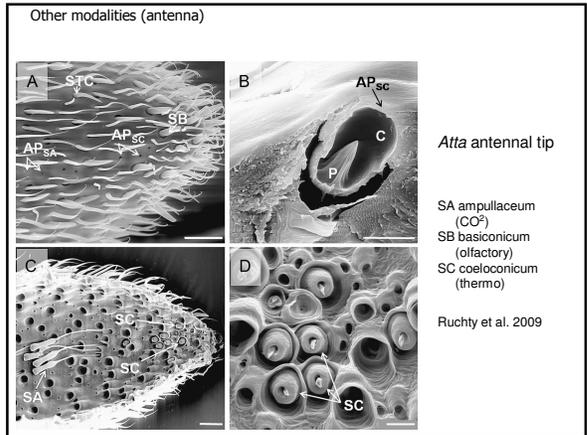
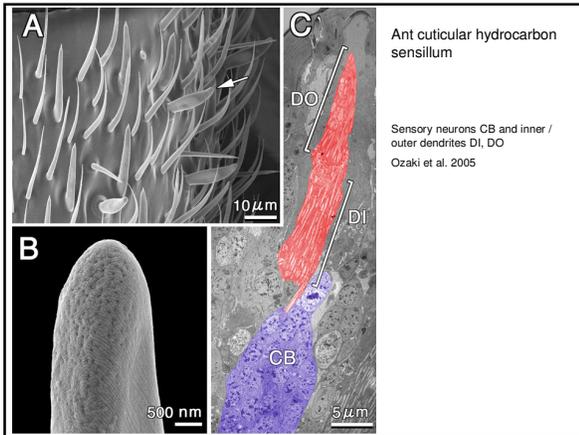
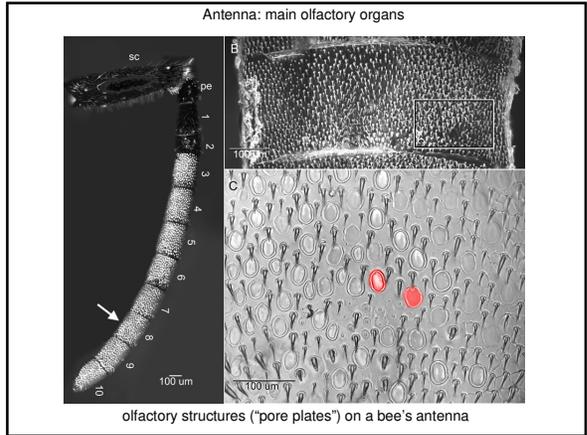
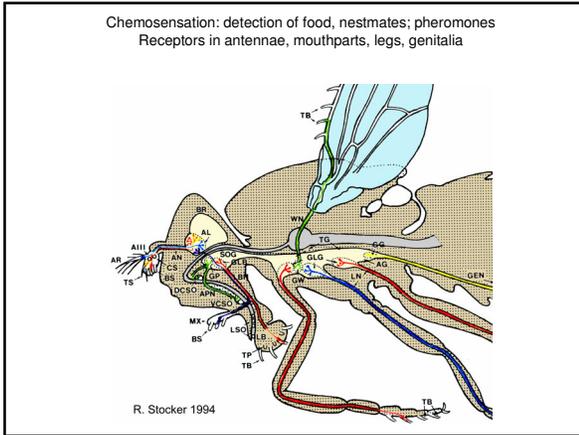
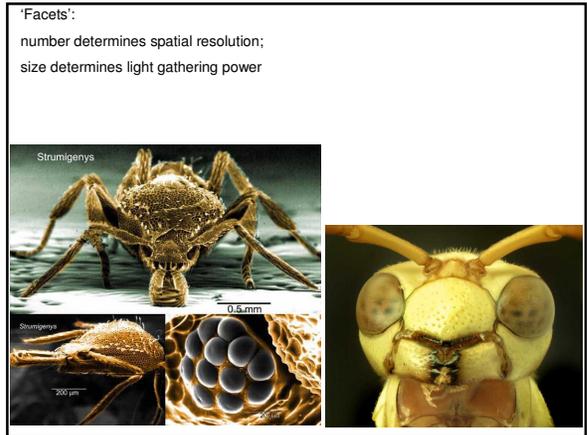
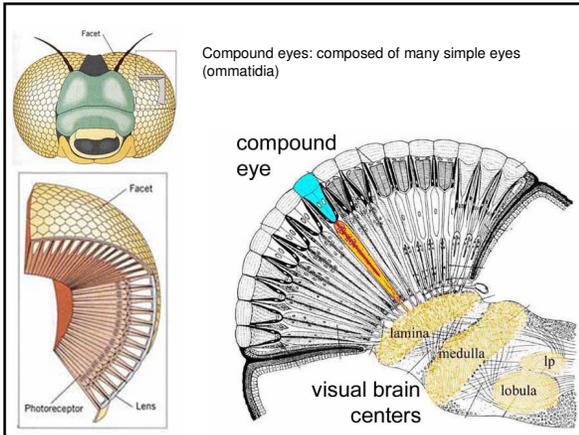
- visual
- mechanosensory (touch, vibration, stretch)
- chemosensory (olfactory incl. pheromones, gustatory)
- thermo / infrared

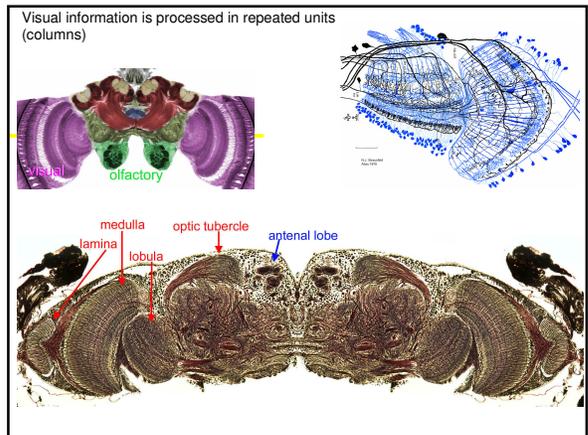
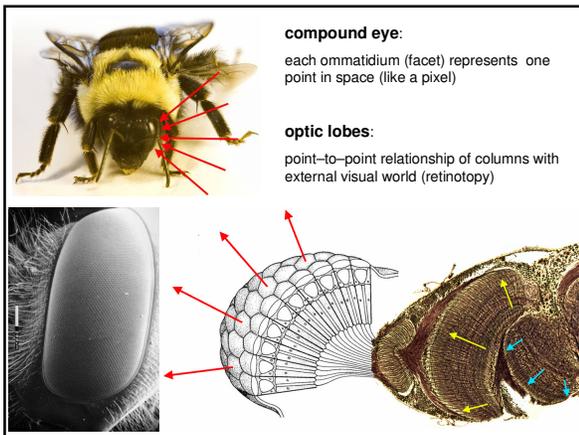
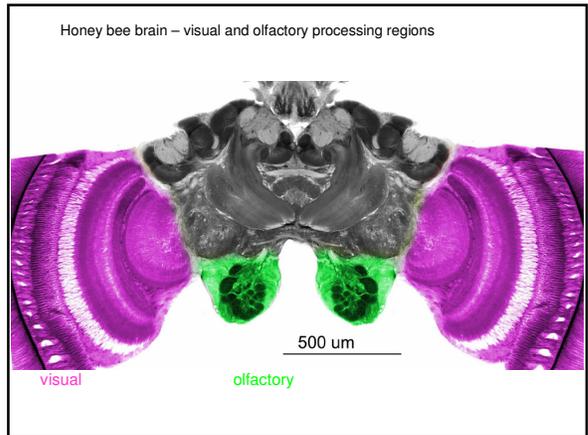
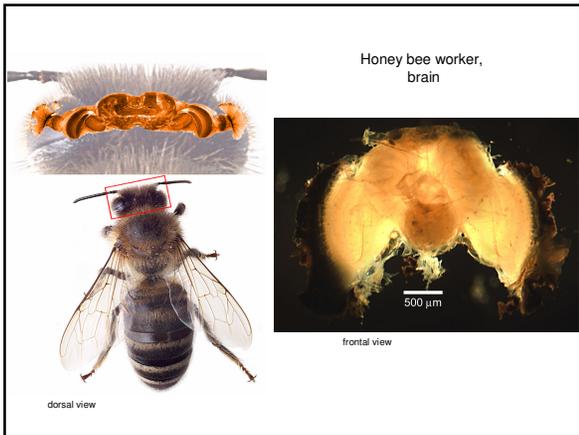
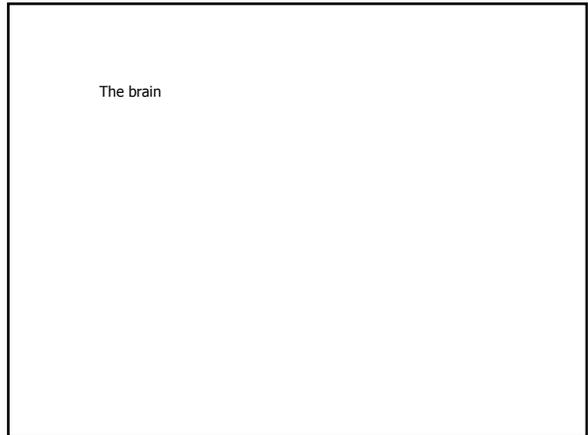
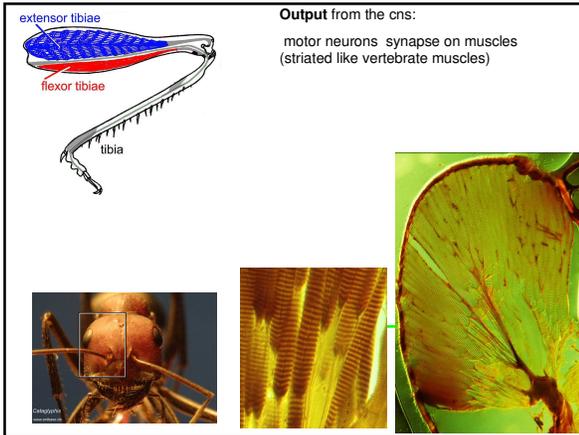
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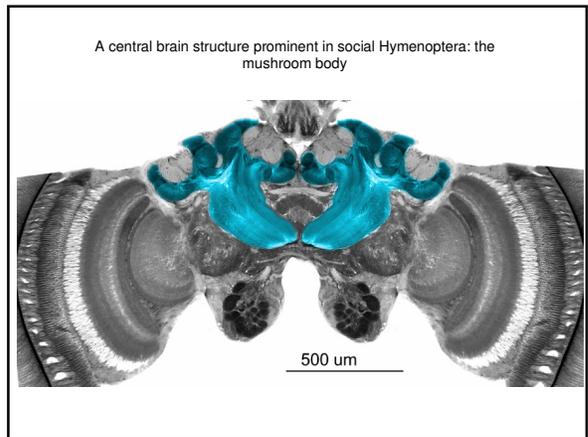
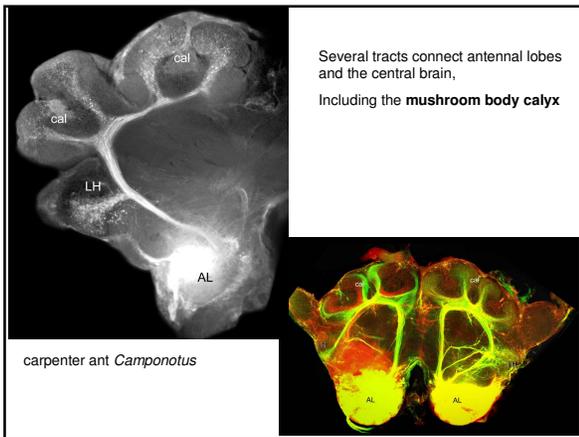
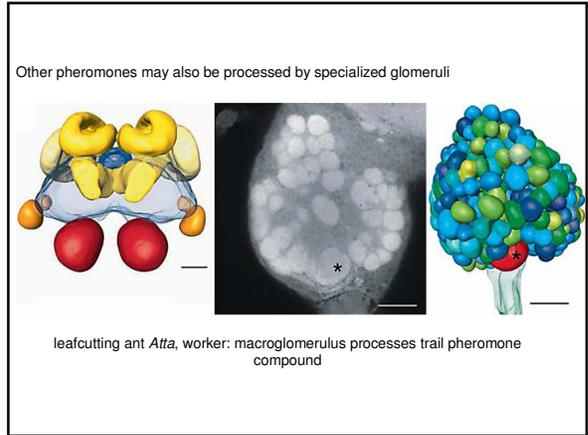
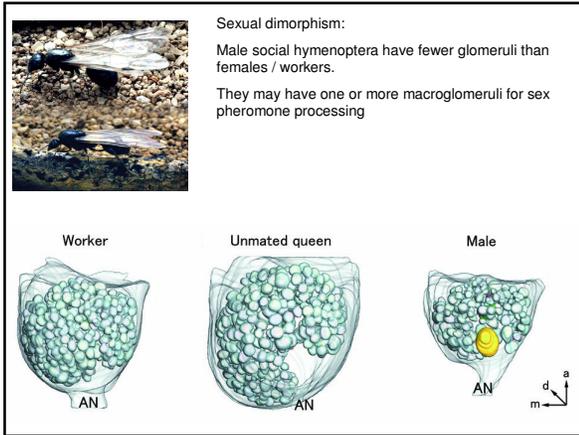
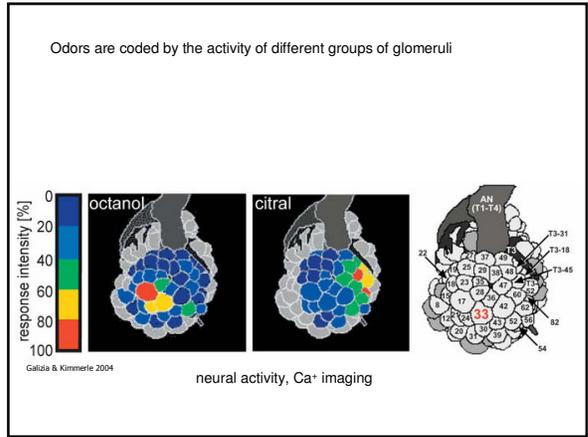
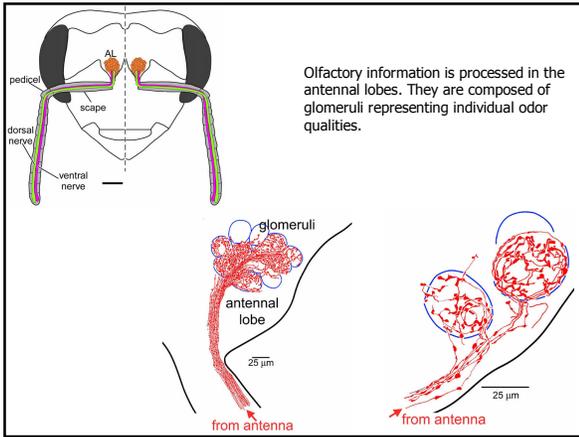
- motor neurons → muscles (glands)
- neurosecretory cells → hormones

Vision: important for

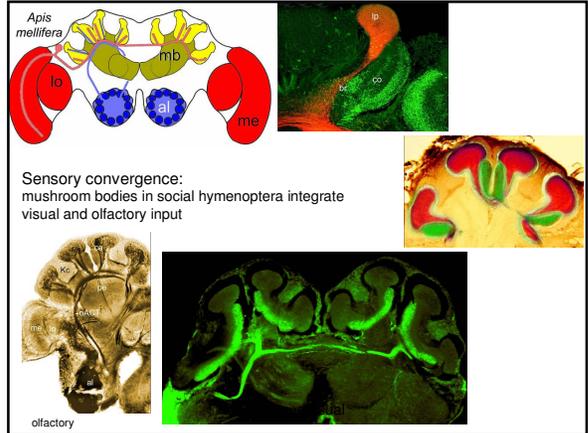
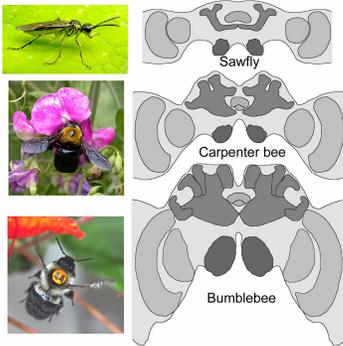
- flight control
- orientation
- prey detection (wasps)
- finding flowers (bees)





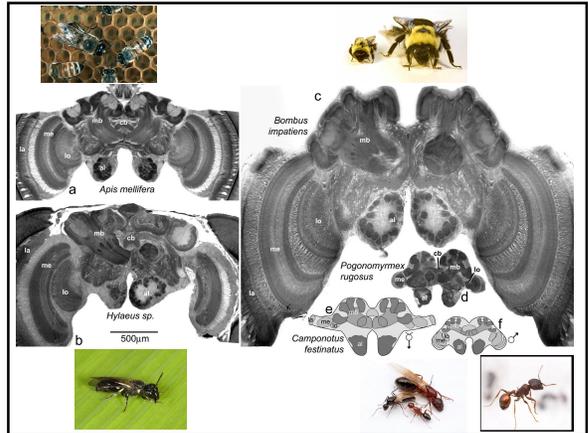


Social Hymenoptera have large mushroom bodies

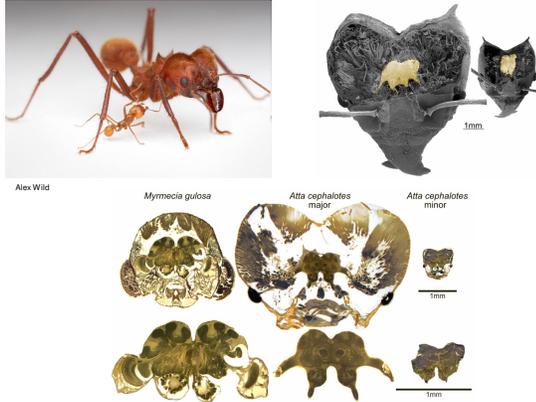


Brain size

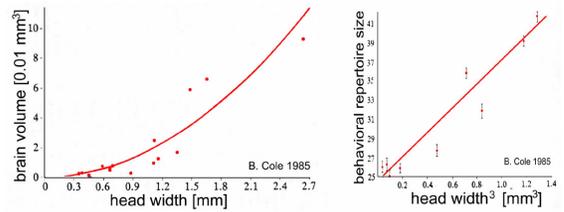
differs



small individuals have relatively larger brains



Body size, brain and mushroom body volume correlate with behavioral repertoire in ants (Cole 1985)



behavioral repertoire difficult to quantify!

Brain size and computational capacities

What matters:

- number of neurons
- number of neuronal arborizations
- number and efficacy of synapses
- speed of synapses and conduction velocity

Large brains usually integrate more sensory information
may have more central processing / storage capacities

are metabolically more expensive

Brain size:

Because of **division of labor**, social insects may **not** need particularly large brains.

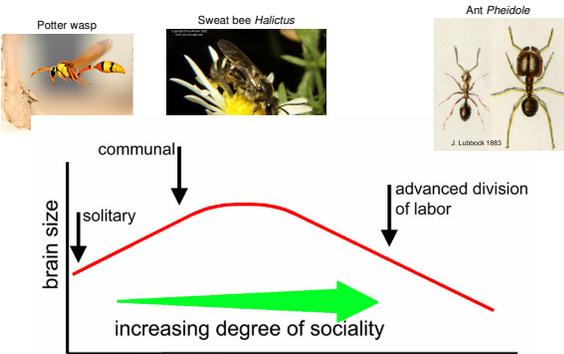
Workers: reduced behavioral repertoires- no need for any sexual behavior
(one of the most important behavioral activity in solitary insects)

Workers may be further specialized (e.g. forager, soldier etc.)

Queens, males: fed and cared for by workers

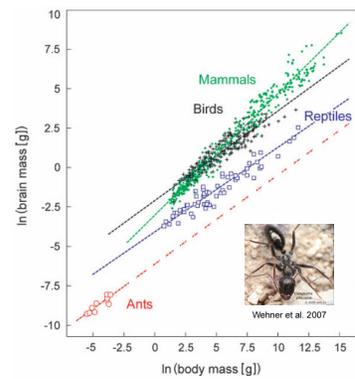
→ smaller behavioral repertoires allow for smaller brains

Advanced social insects may **not** need particularly large brains.



Ants seem to have smaller brains compared to 'equally sized' vertebrates.

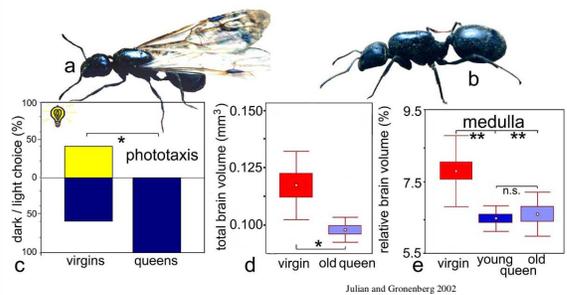
Because of the weight of cuticle??

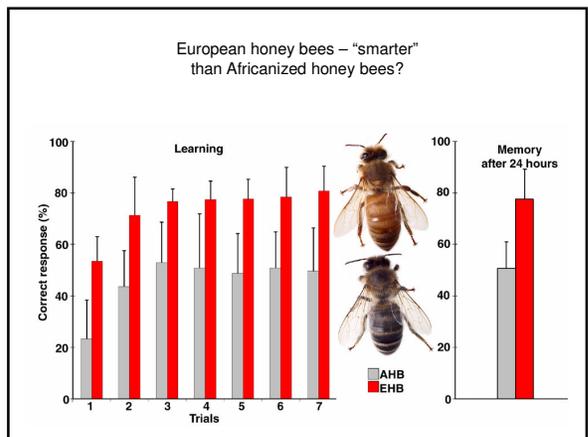
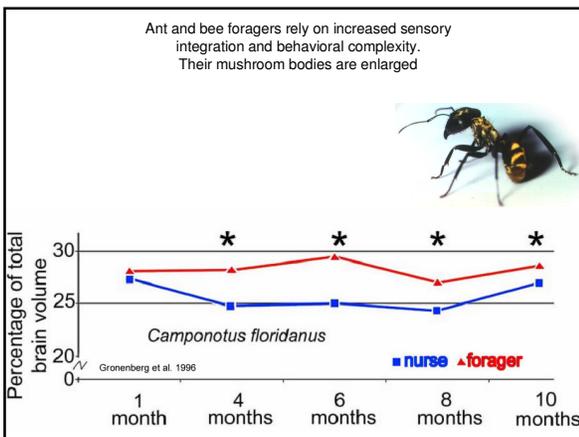
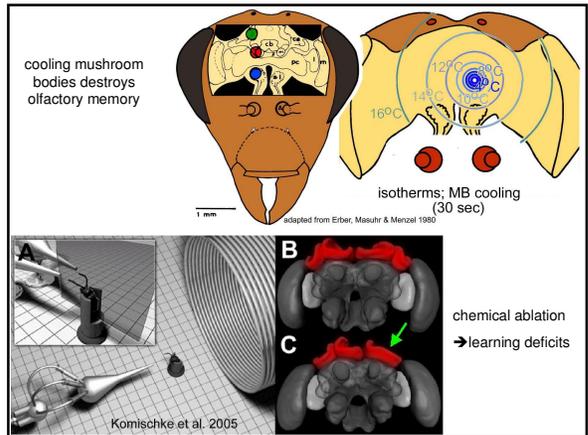
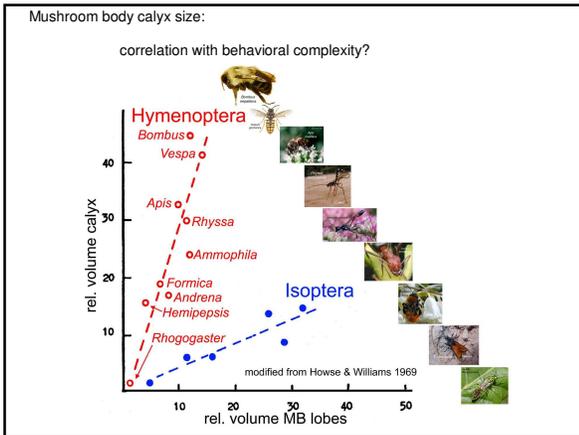
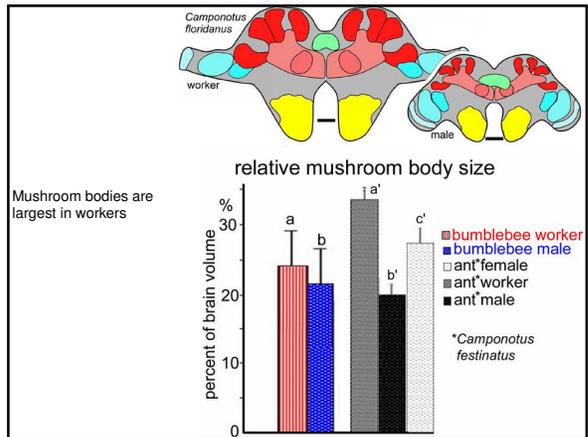
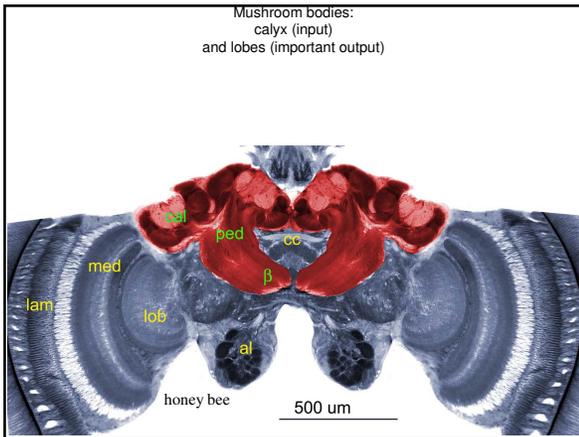


Brain plasticity -

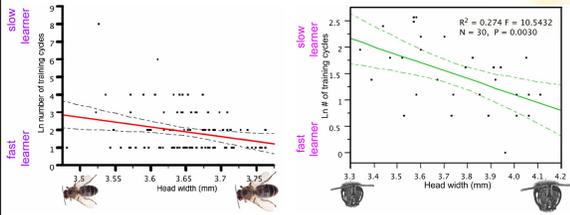
learning & memory, experience

After mating, a queen ant's brain shrinks: adaptation for underground life





olfactory learning: larger bees learn faster and remember longer



and European honey bees are slightly larger than Africanized bees
and, accordingly, have slightly larger brains

