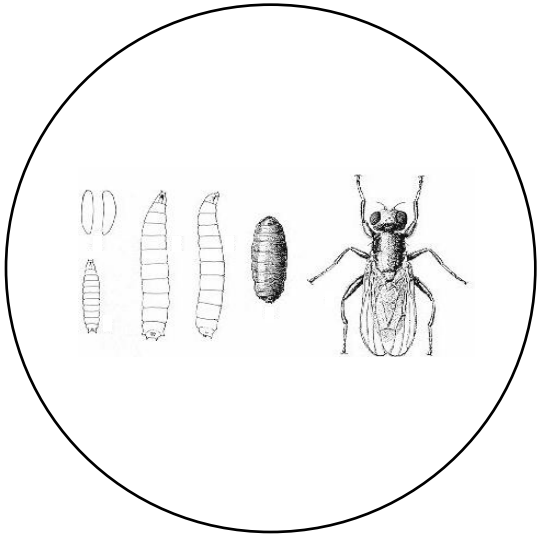
Was (und wie) man von Fliegen lernen kann

Bertram Gerber

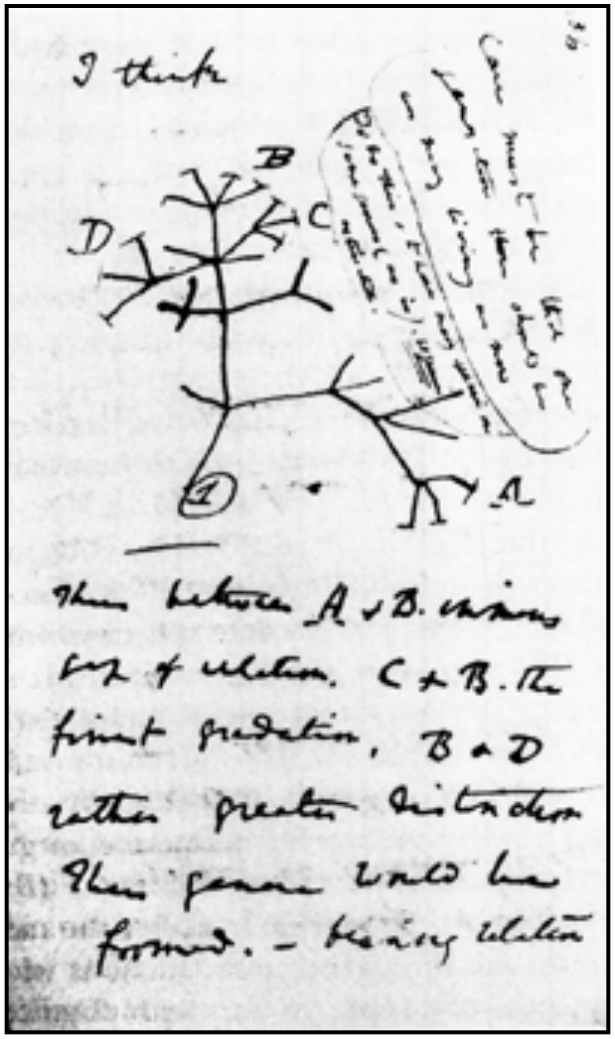
Leibniz Institut für Neurobiologie
Magdeburg



Was die Fliegenforschung beflügelt:
Methoden der Transgenexpression

Ein Forschungsbeispiel:
Ort einer Gedächtnisspur

Die ‚Schichten' des Lebendigen



Verhalten

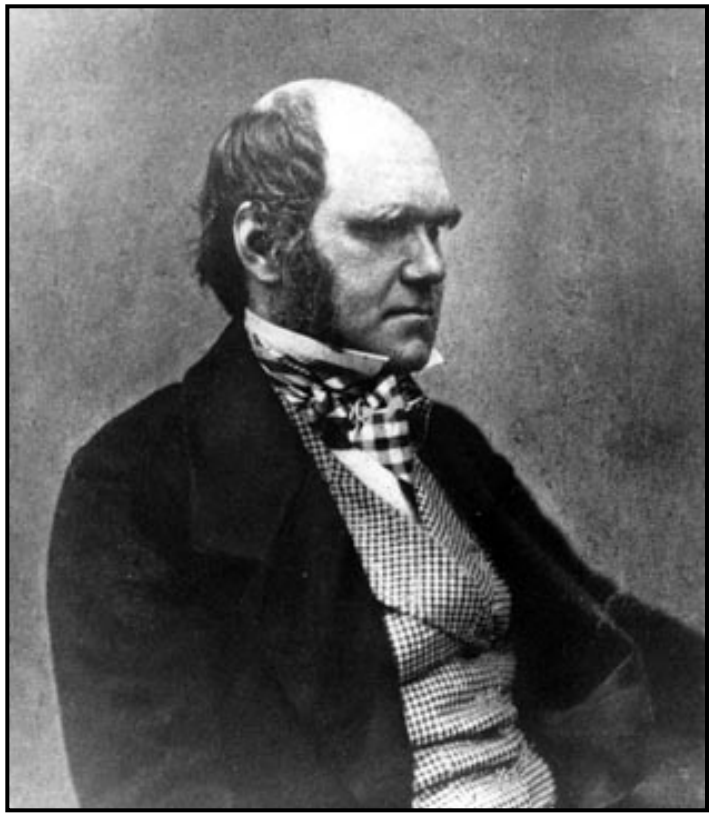
Schaltkreise, Gehirn

Zellen

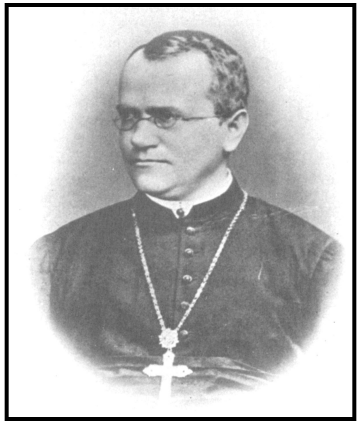
Proteine

DNA, RNA

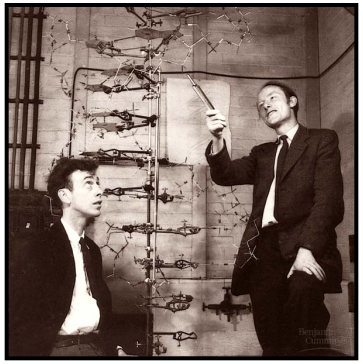
Erbliche Aspekte menschlicher Erkrankungen lassen sich auch an Fliegen erforschen



Charles Darwin



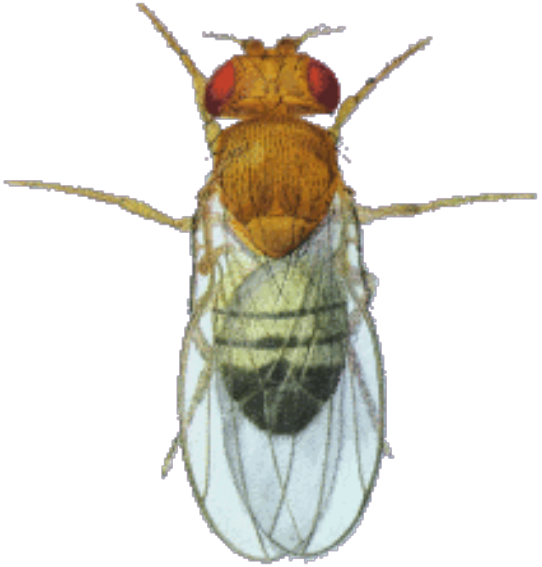
Gregor Mendel

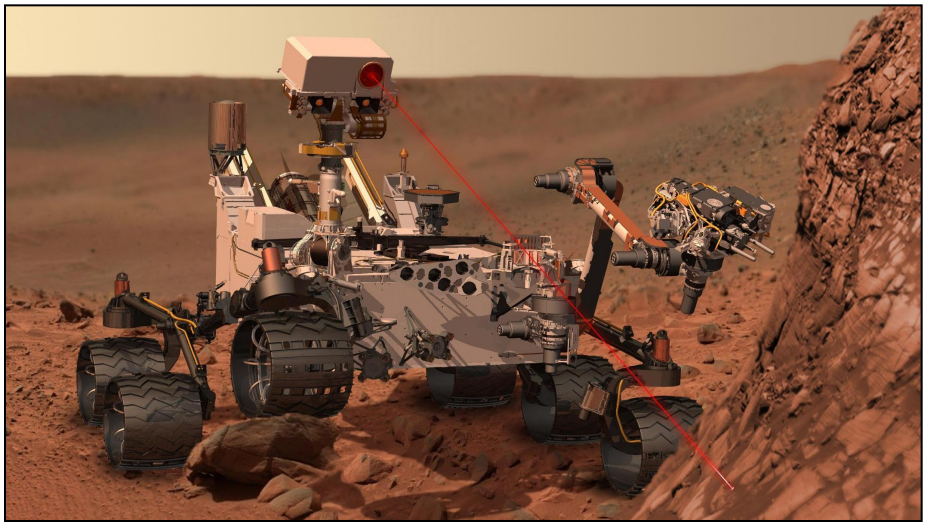


James Watson, Francis Crick

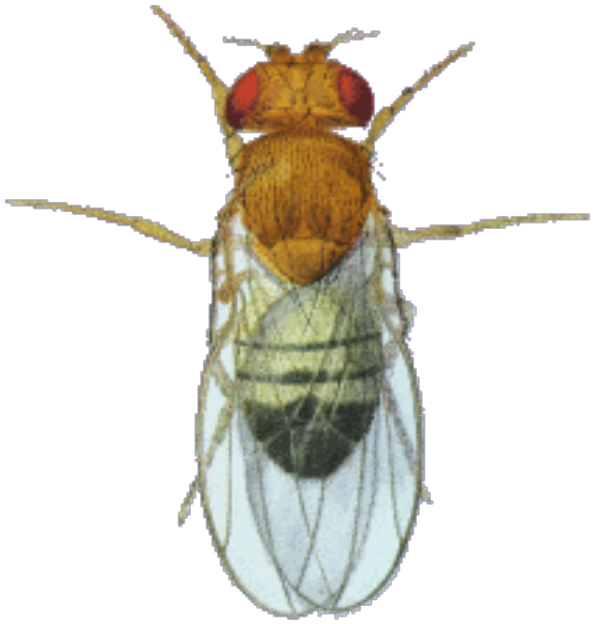
Alois Alzheimer

'Intelligente' Minischaltkreise lassen sich technisch anwenden

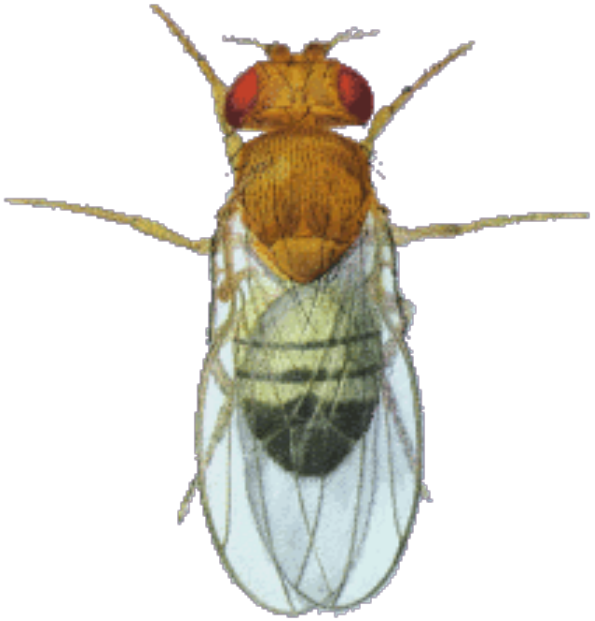




Wo? Was?



X

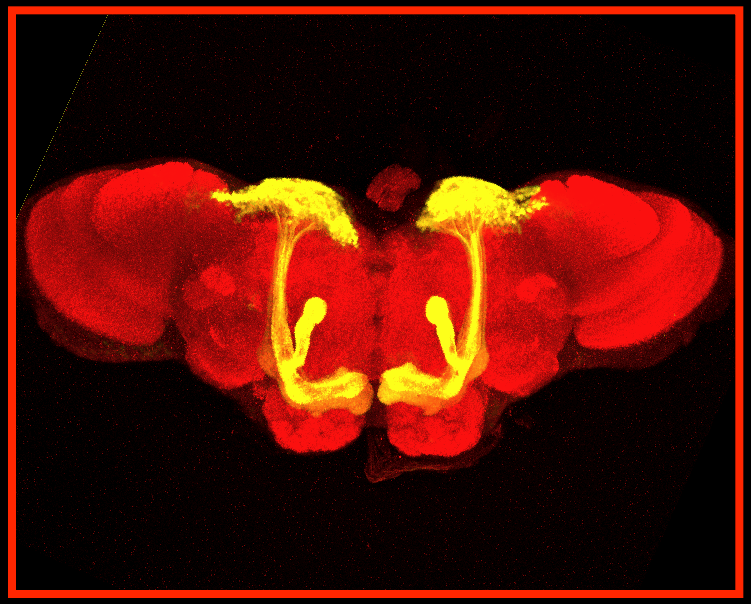


WO? Gal4-Treiber Stamm
Zellspezifität

WAS? UAS-Effektor Stamm
Molekulare Spezifität

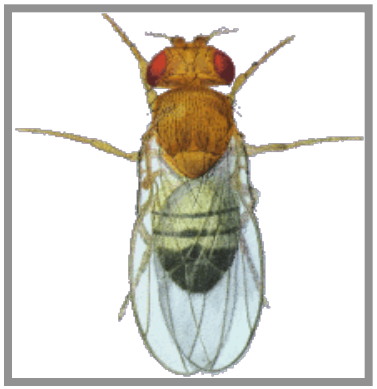
Alle Zellen haben dieselbe Erbinformation, und sind doch sehr verschieden...

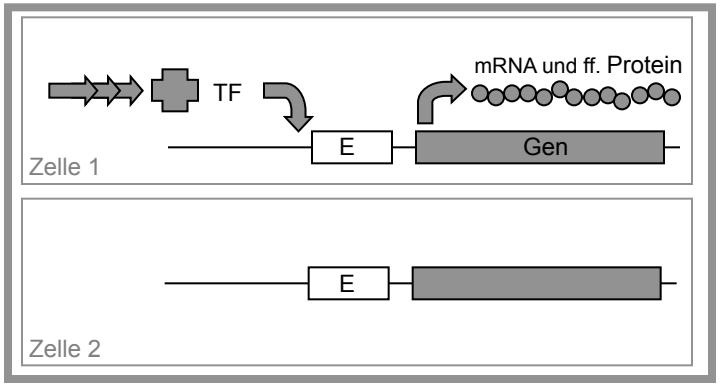
Gen 1: An
Gen 2: Aus



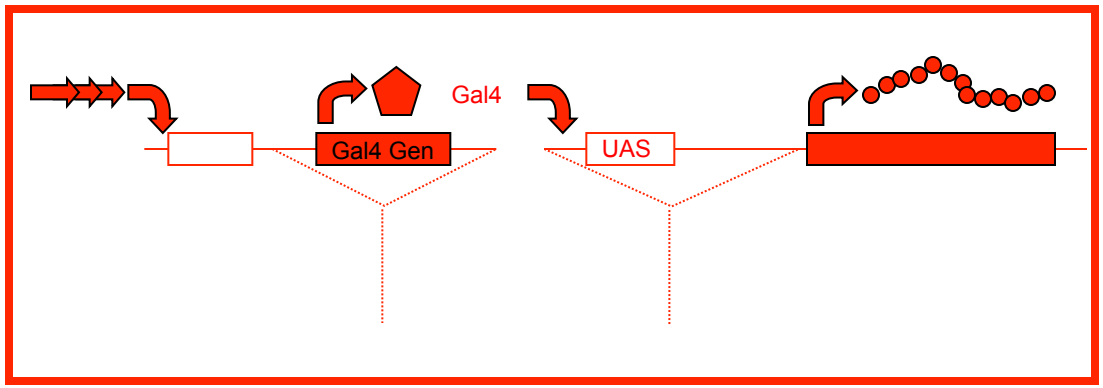
Gen 1: Aus
Gen 2: An

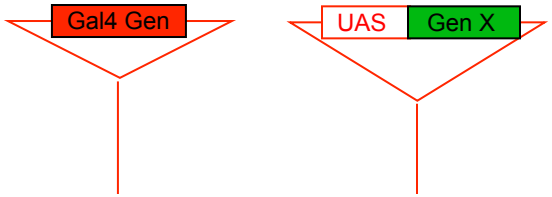
Zellen sind verschiedenen weil verschiedene Transktiptionsfaktoren (TF) vorhanden sind, die je verschiedene Erkennungsstellen benötigen und je verschiedene Gene aktivieren



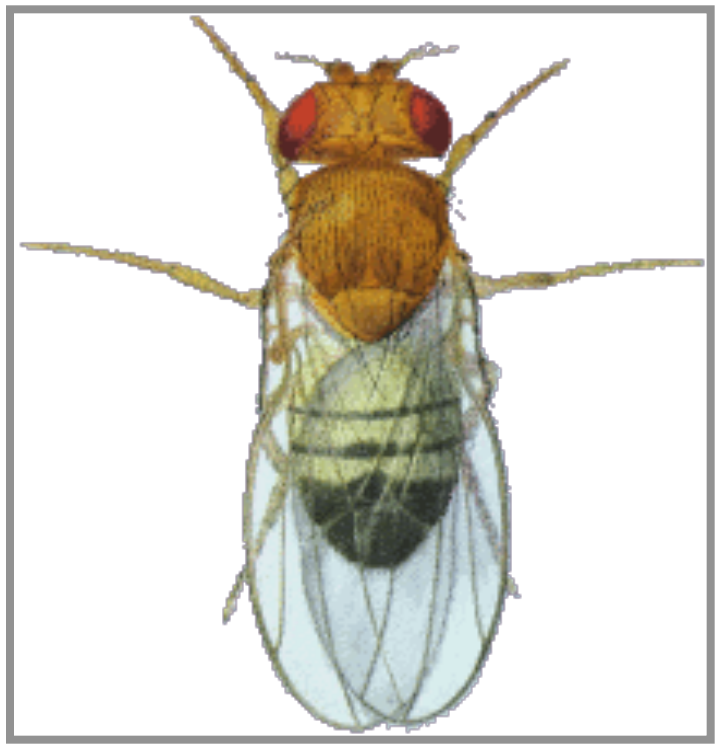


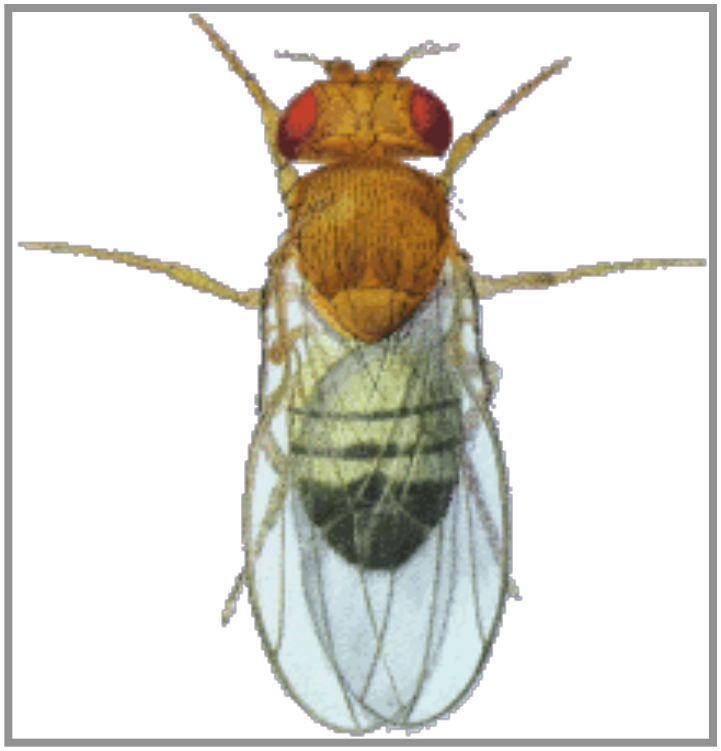
Andere Spezies haben andere Transkiptionsfaktoren mit je anderen Erkennnungsstellen

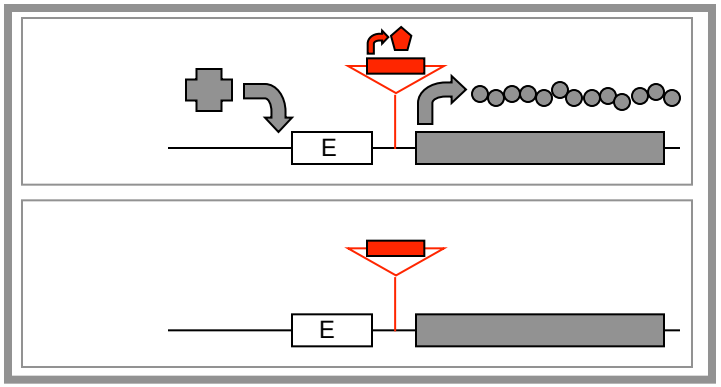


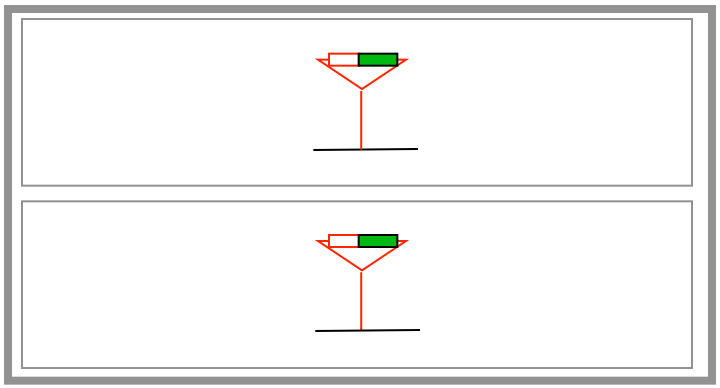


Jedes Gen der Wahl kann hinter die Erkennungssequenz für das Gal4 Protein (das ist: die UAS Sequenz) platziert werden









WO?
“Treiber” Fliege

WAS?
“Effektor” Fliege

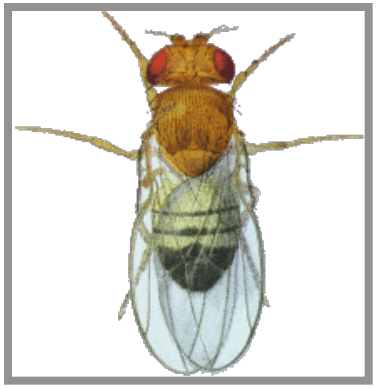
In nur den Zellen...

... in denen die fliegen-eigene Erkennungssequenz E aktiviert ist

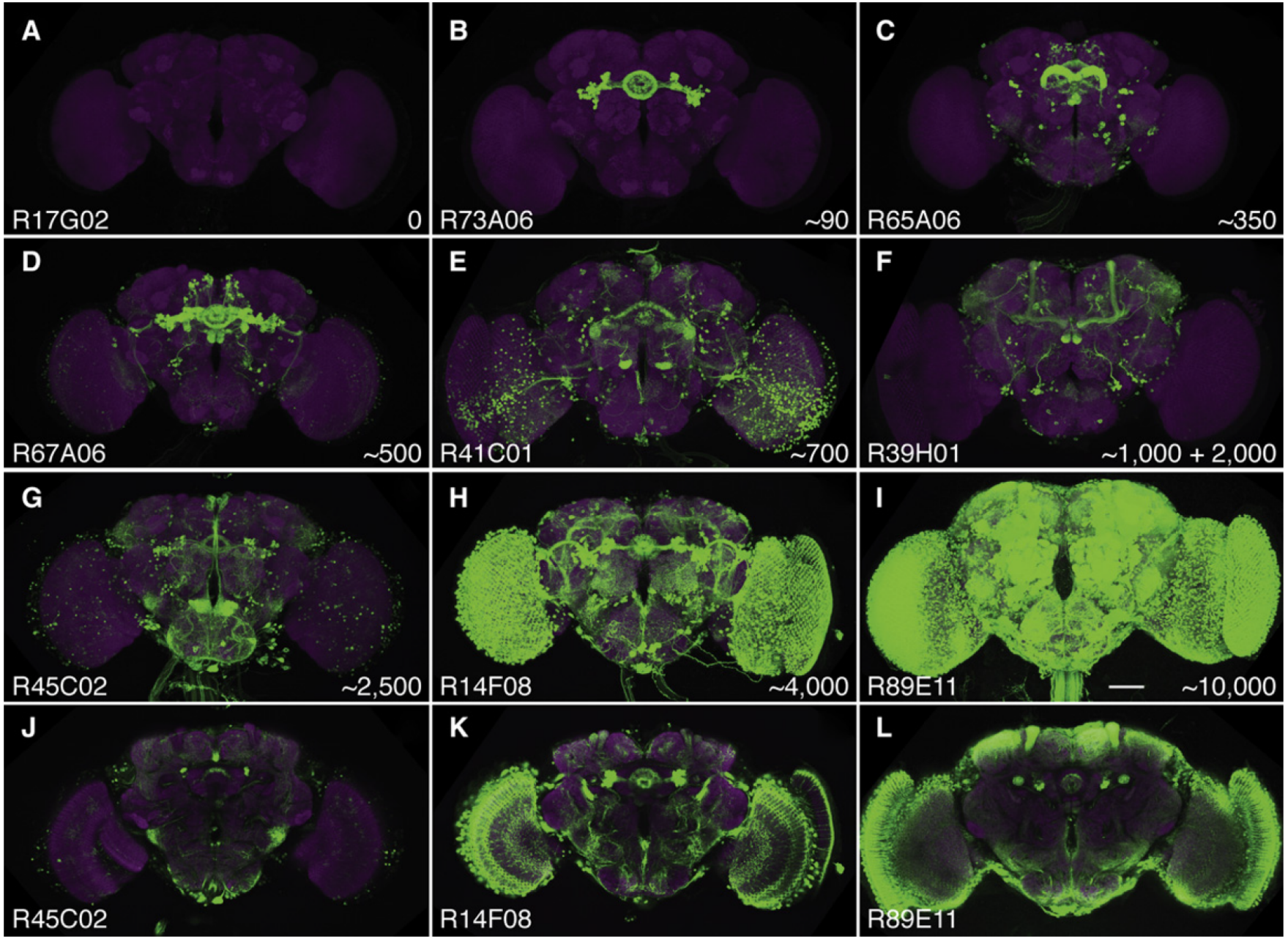
... wird das Gal4 Gen aktiviert und das Gal4 Protein gebildet

... aktiviert das Gal4 Protein seine UAS Erkennungssequenz

... wird das Effektorgen aktiviert und das Effektorprotein gebildet



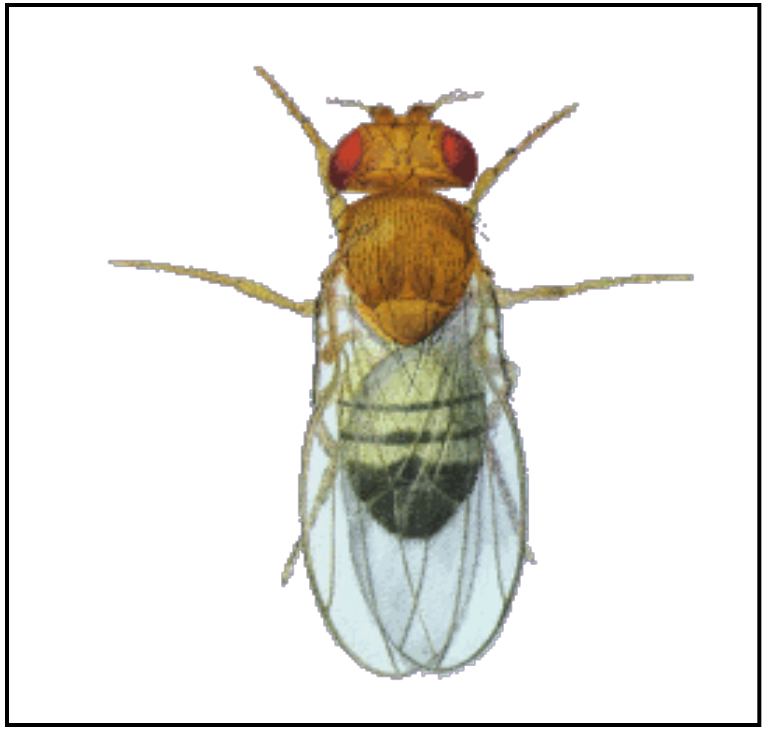
Nachkomme aus Treiber- und Effektorfliege



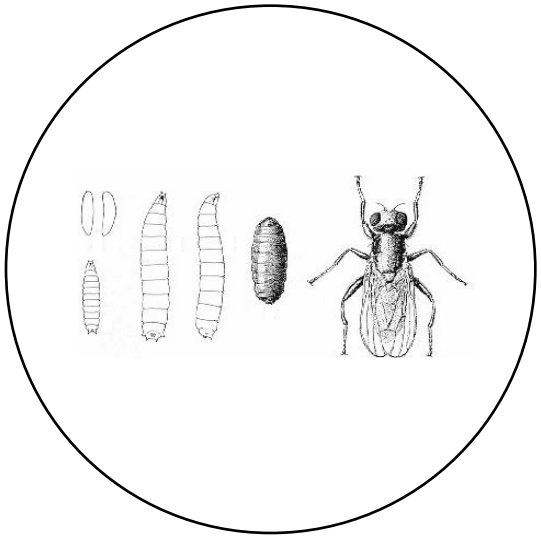
Jenett et al 2012 Cell Reports

Was? Gene, deren Genprodukte...

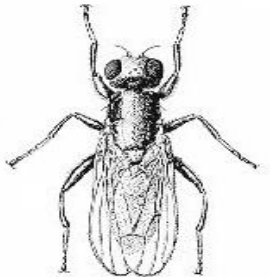
... Nervenzellen markieren
... Nervenzellen abtöten
... Aktionspotentiale blocken
... Synapsen blocken
... Nervenzellen (in)aktivieren
... Aktivität messen
... Enzymaktivität messen
... Genfnktn. wiederherstellen
... Genfnktn. abschalten
...



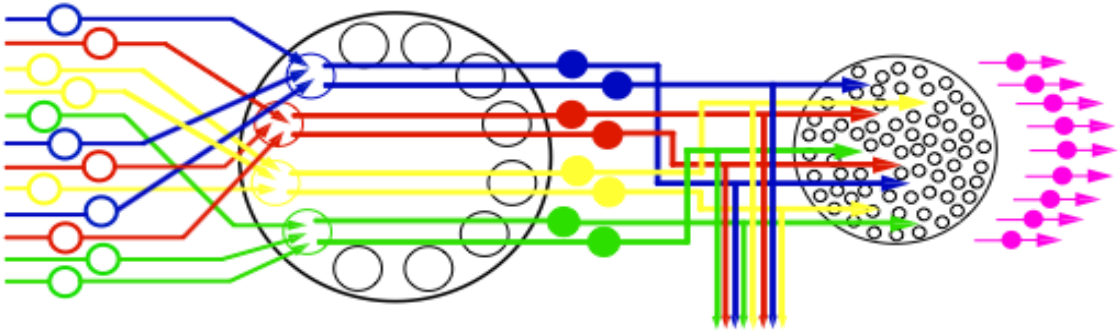
WAS? UAS-Effektor Stamm
Molekulare Spezifität



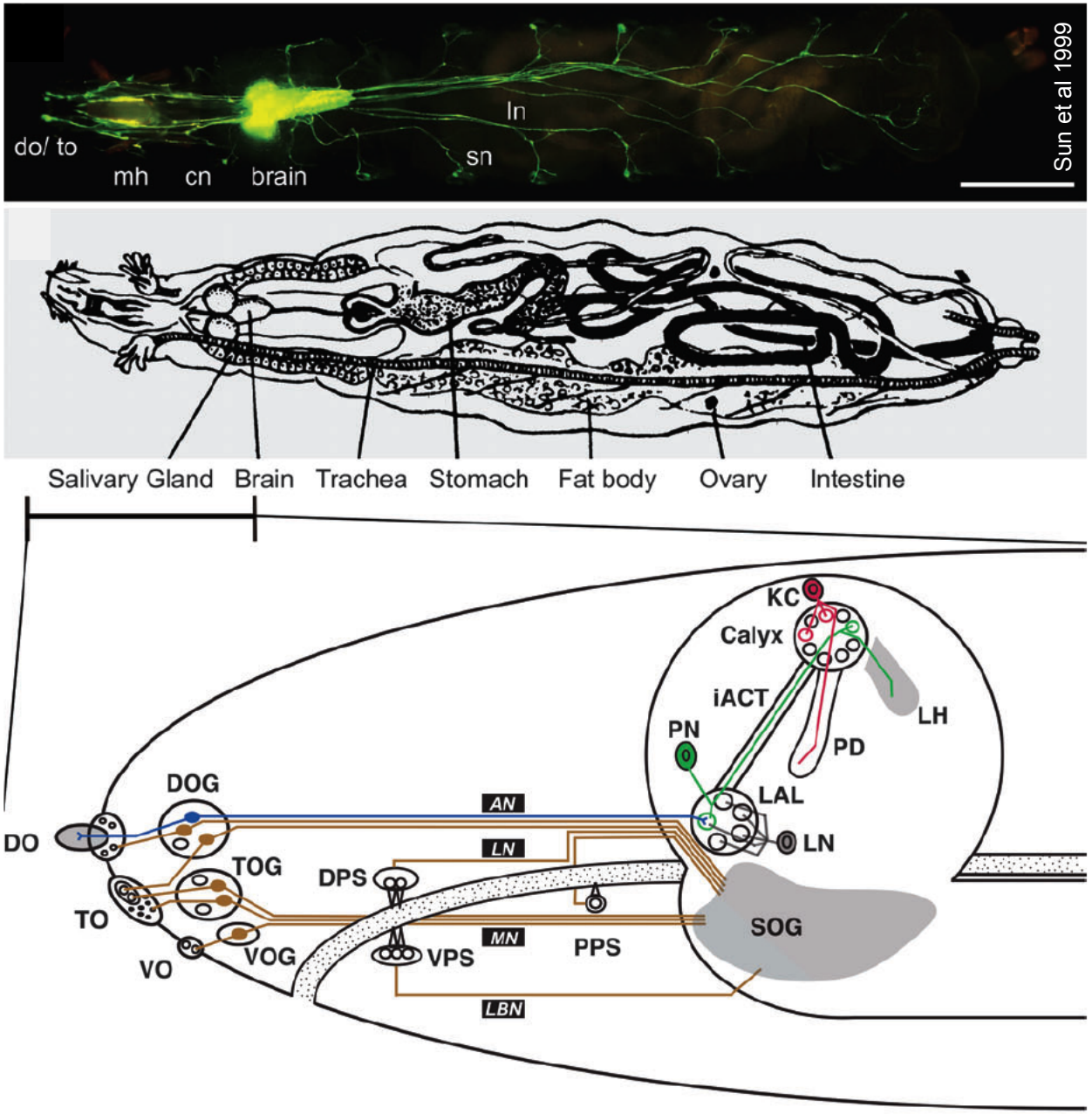
A research example:
Neurogenetics of a memory trace

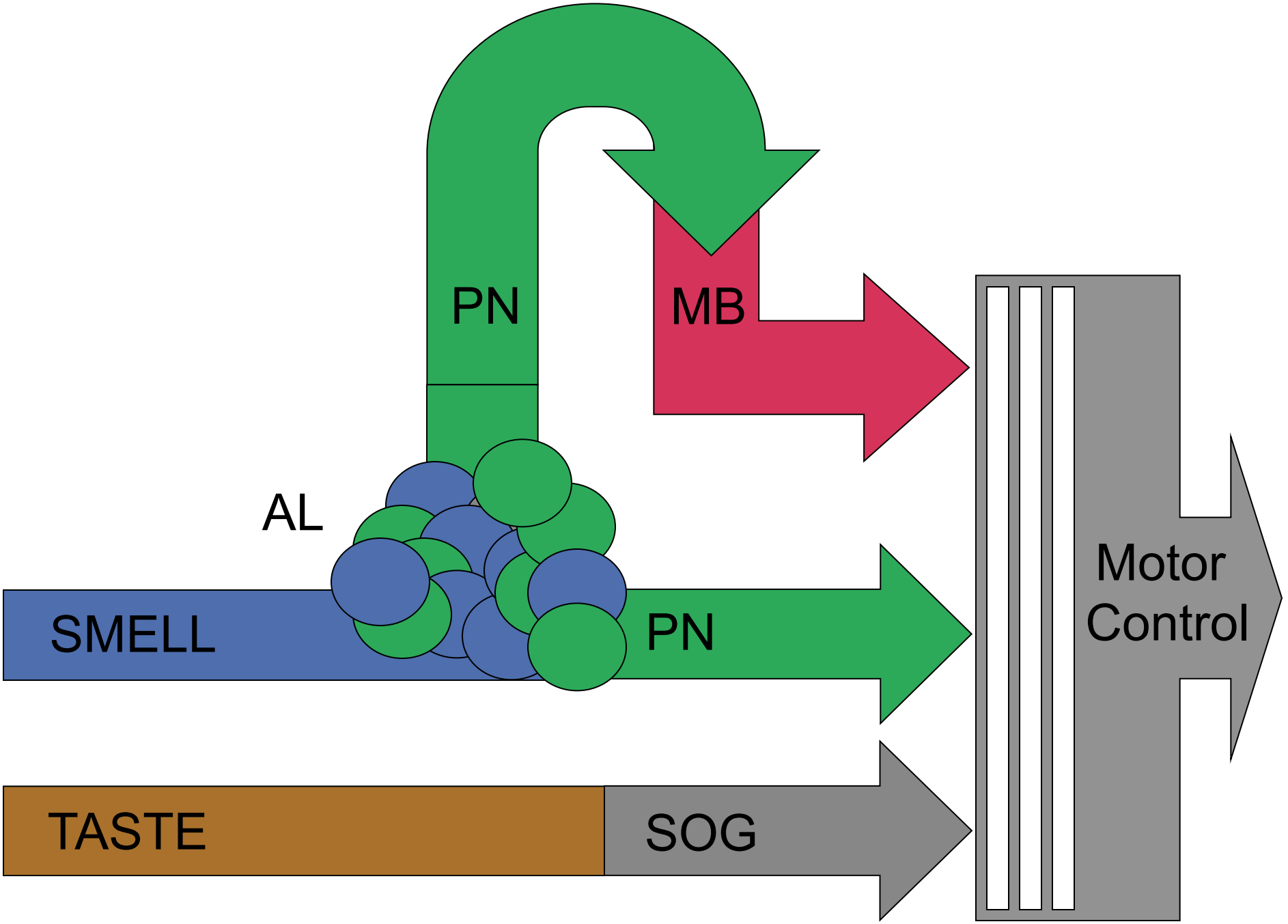


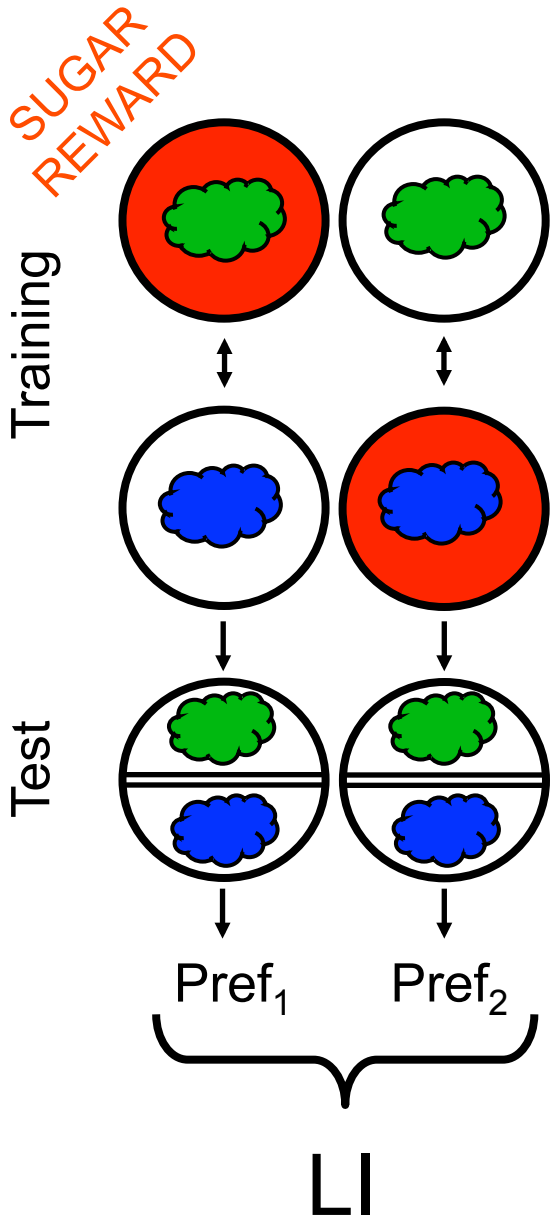
1300 50 150 ~ 200 ~2500

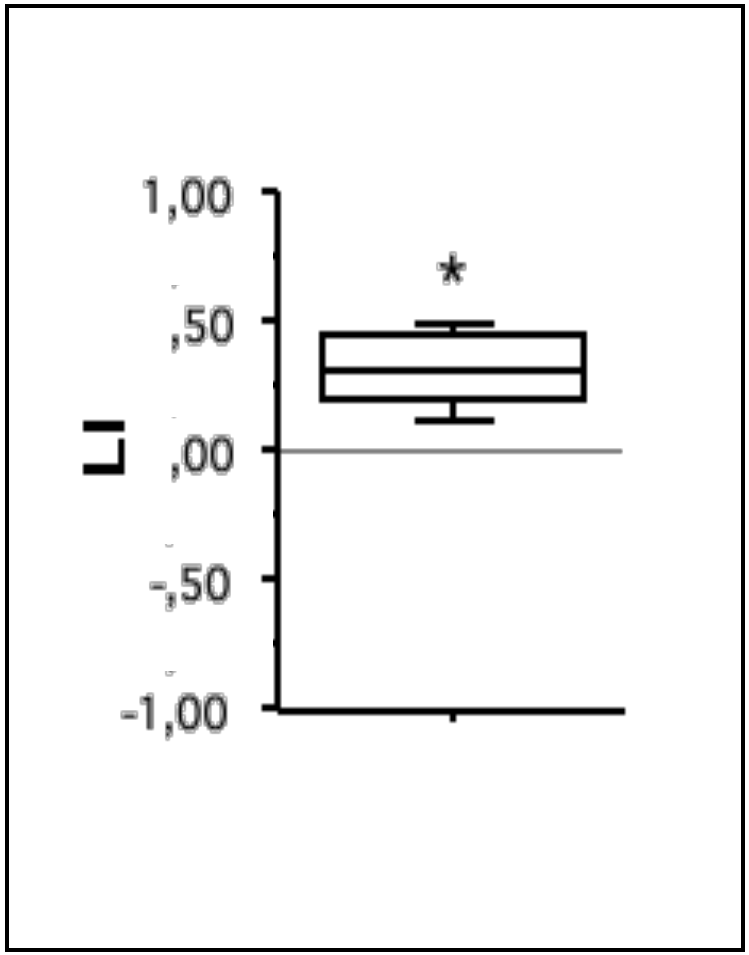


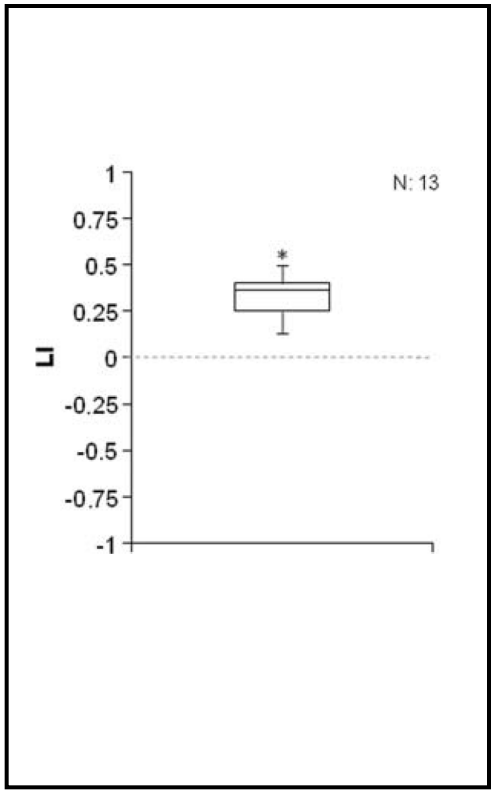
21 21 ~25 ~35 ~600

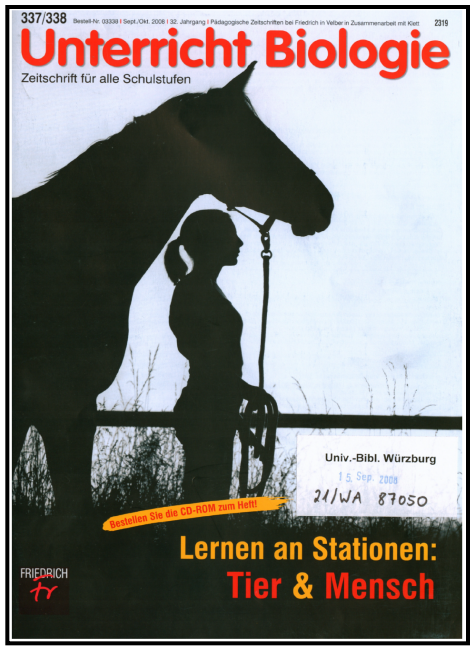

do/ to
mh
cn
brain
ln
sn
Sun et al 1999
Salivary Gland
Brain
Trachea
Stomach
Fat body
Ovary
Intestine
KC
Calyx
iACT
LH
PN
PD
LAL
LN
DOG
AN
LN
DO
TOG
DPS
TO
MN
PPS
SOG
VOG
VPS
VO
LBN


PN
MB
AL
SMELL
PN
Motor
Control
TASTE
SOG

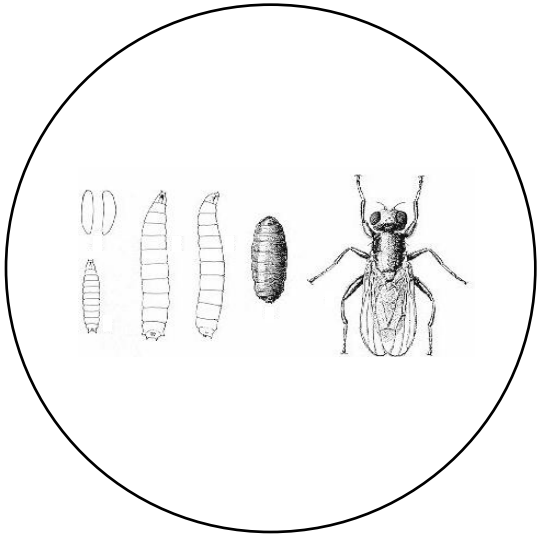

SUGAR
REWARD
Training
Test
Pref1
Pref2
LI


1,00
,50
,00
-,50
-1,00
LI
*


N: 13
LI
1
0.75
0.5
0.25
0
-0.25
-0.5
-0.75
-1
*



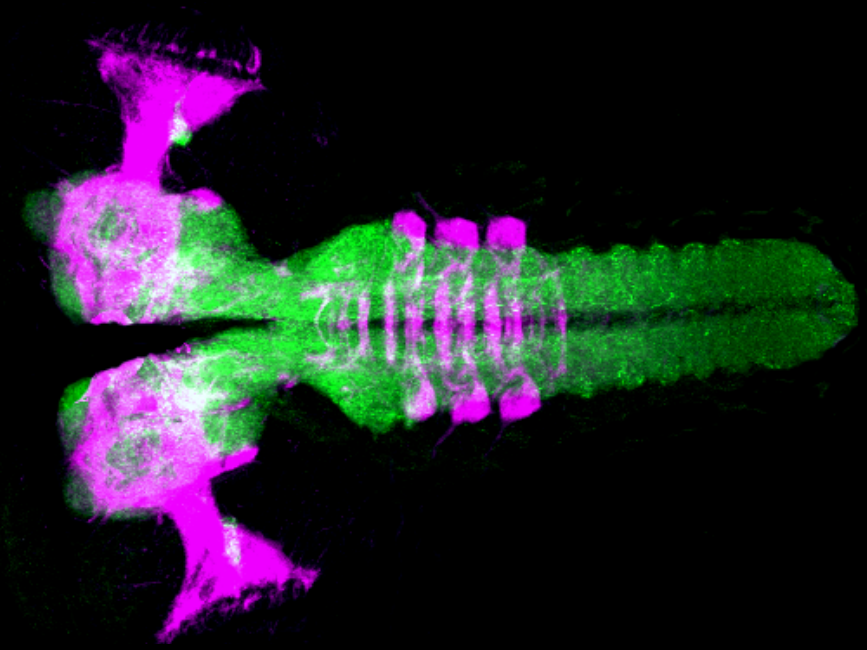
Unterricht Biologie

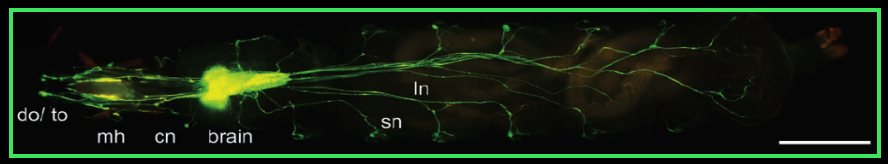


Was die Fliegenforschung beflügelt:
Methoden der Transgenexpression

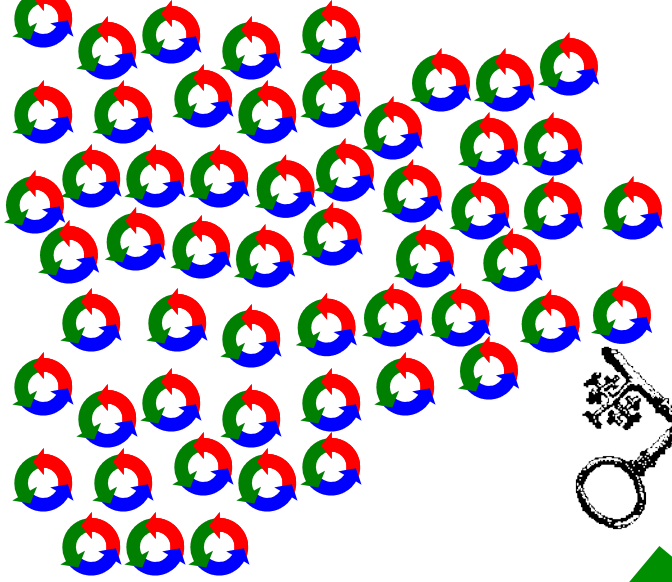
Ein Forschungsbeispiel:
Ort einer Gedächtnisspur

Defined change in behaviour- defined site of memory trace?





Synapsin function

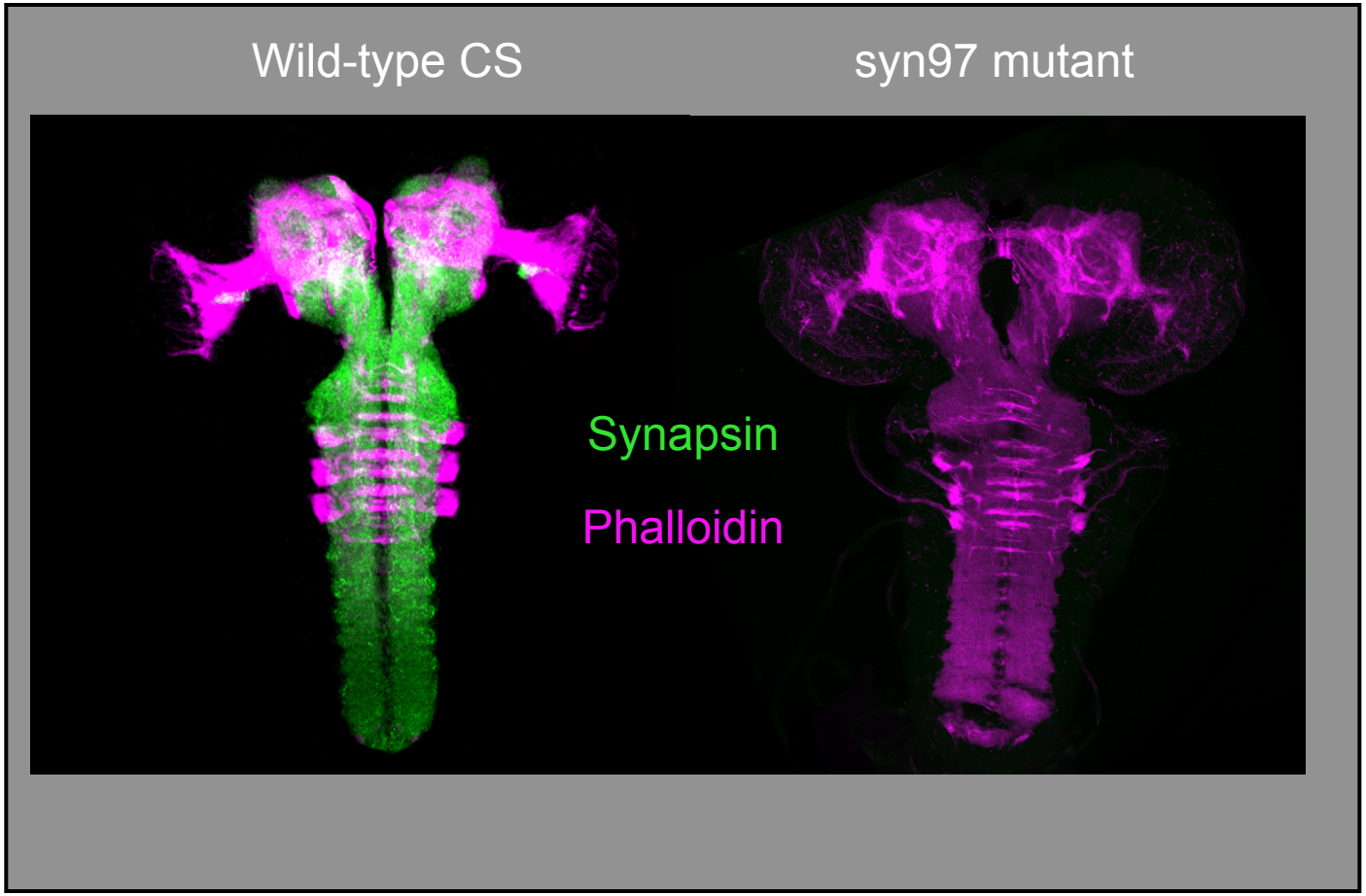


Tethering vesicles to cytoskeleton

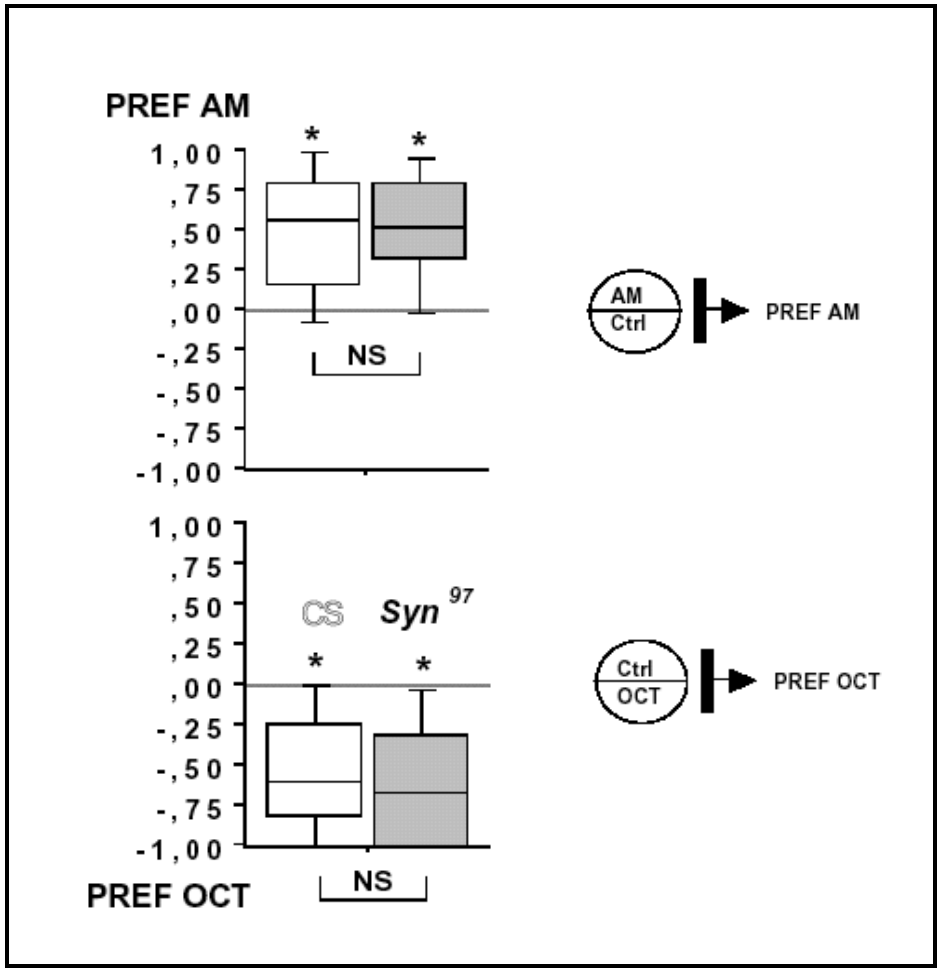
Phosphorylation-dependent REGULATION OF reserve pool

More vesicles available for NEXT action potential

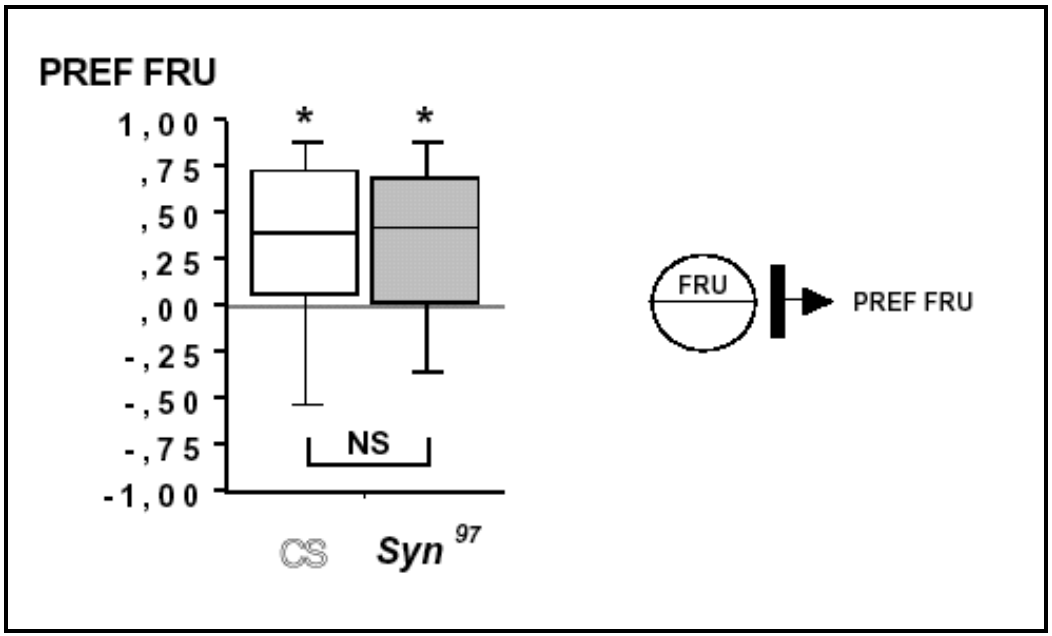
The syn97 mutant lacks Synapsin



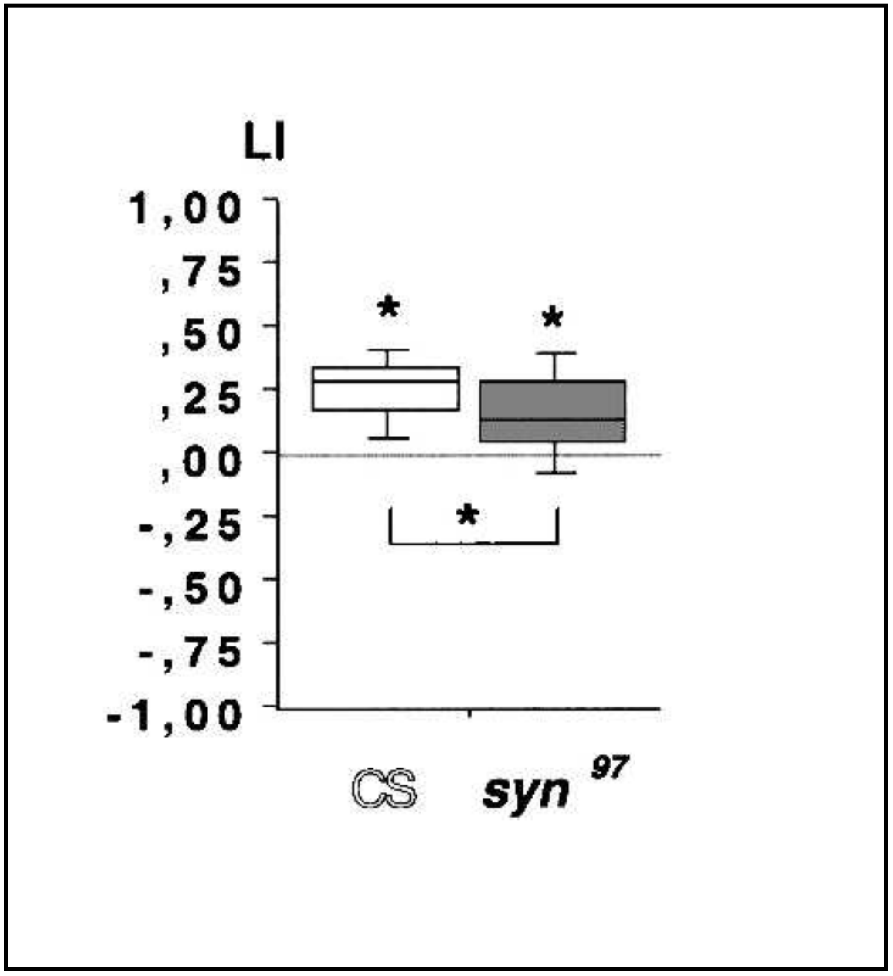
Ability to smell remains intact



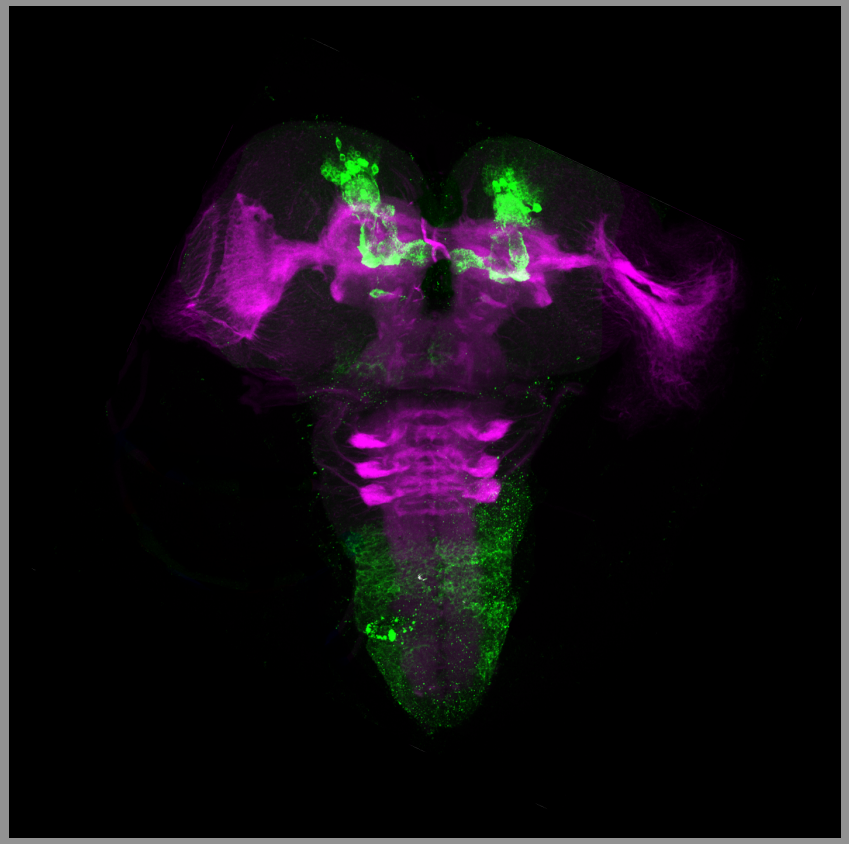
Ability to taste remains intact



Learning ability reduced to half

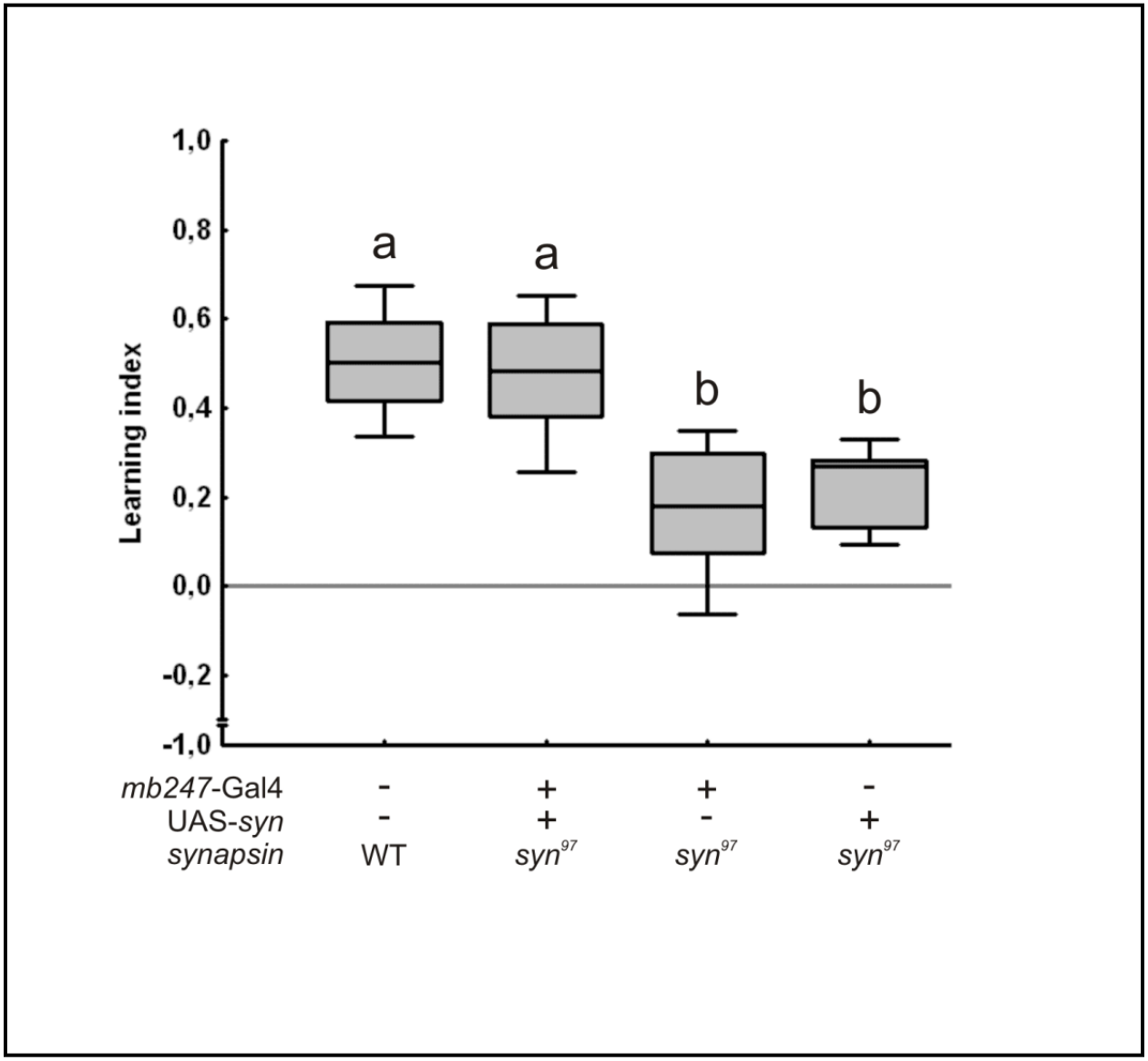


Locally restoring Synapsin @ mushroom body...

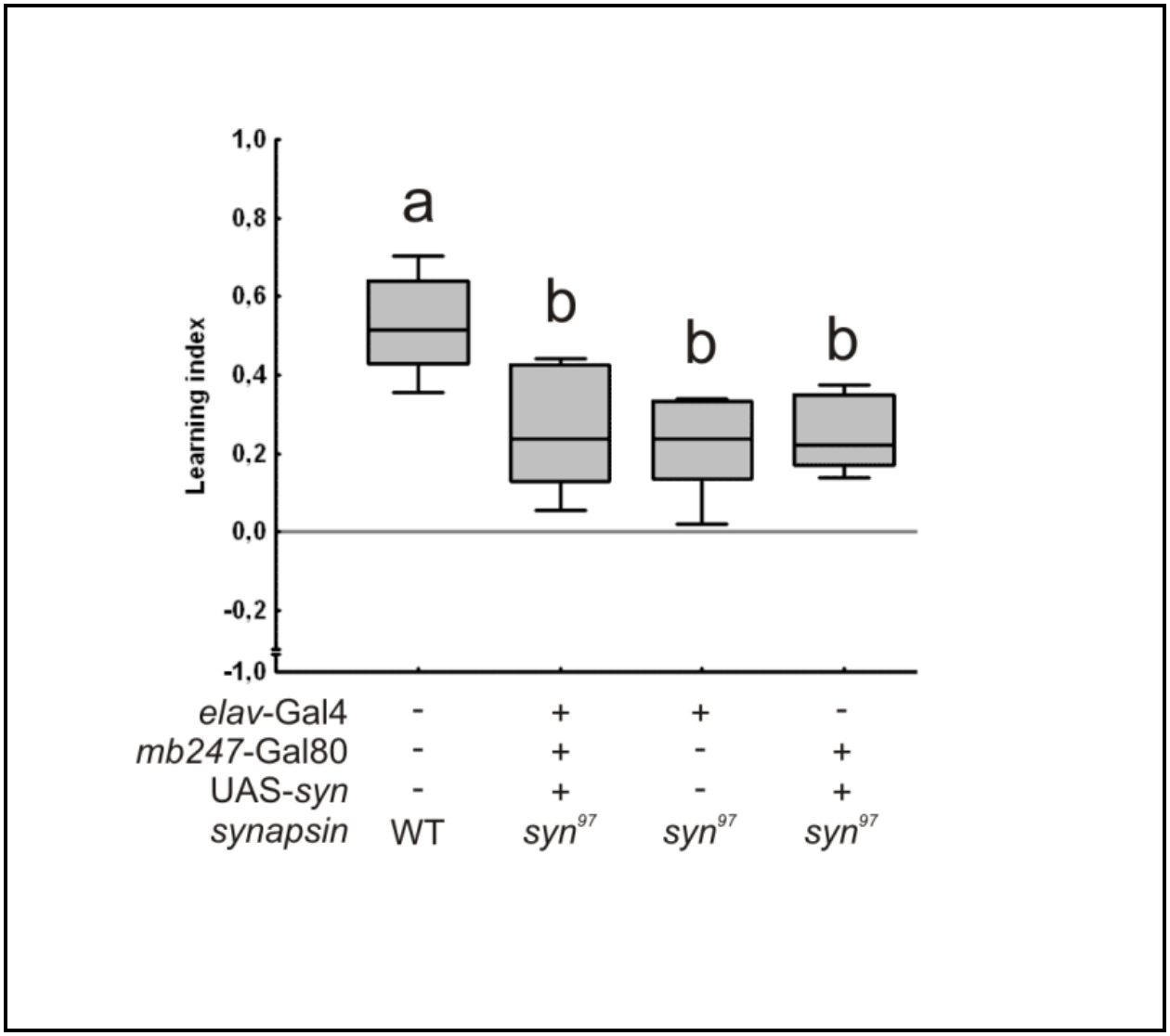


mb247GAL4
UAS-syn
syn97

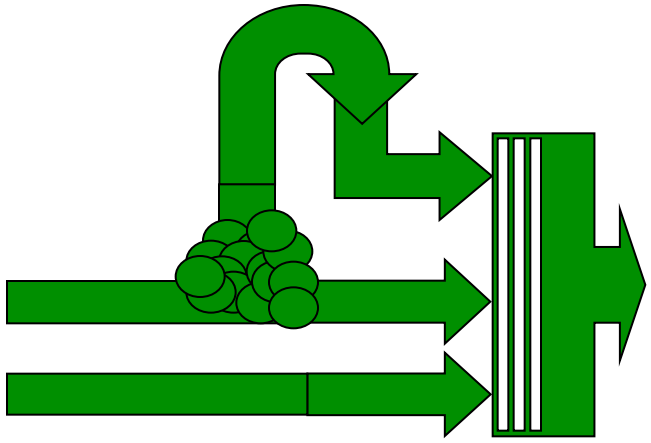
... fully restores learning

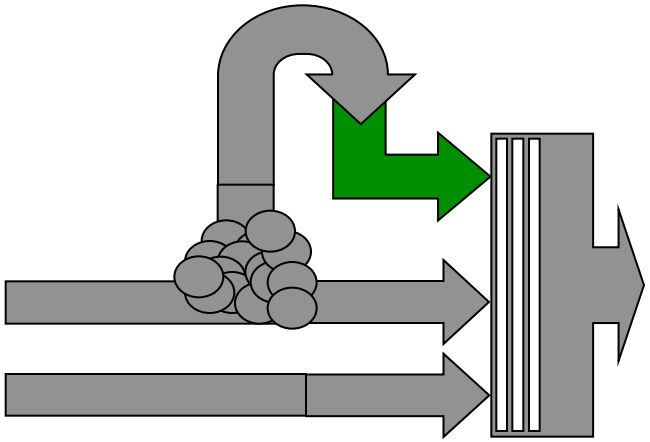


No rescue by expressing only outside mushroom body

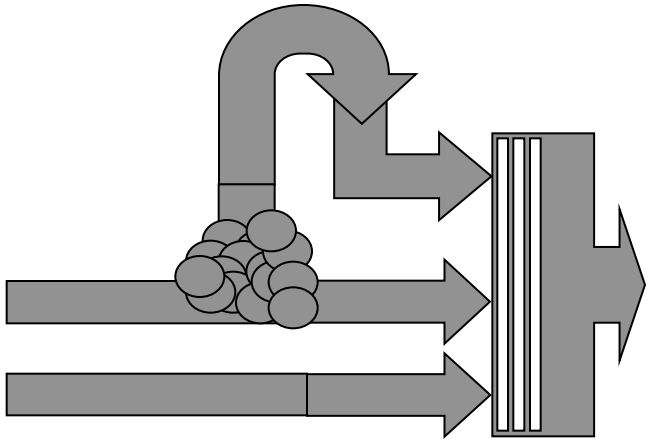


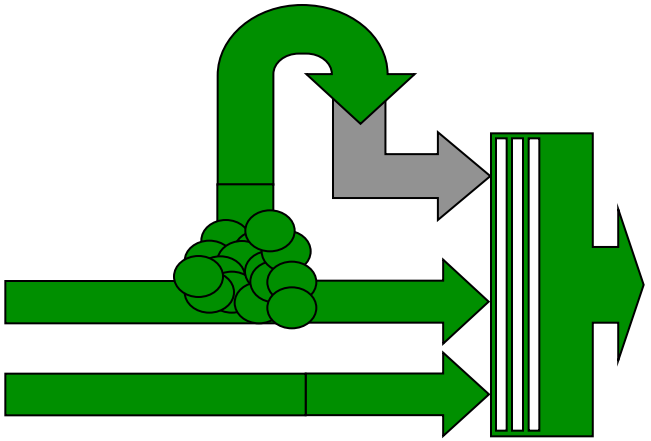
Learning intact

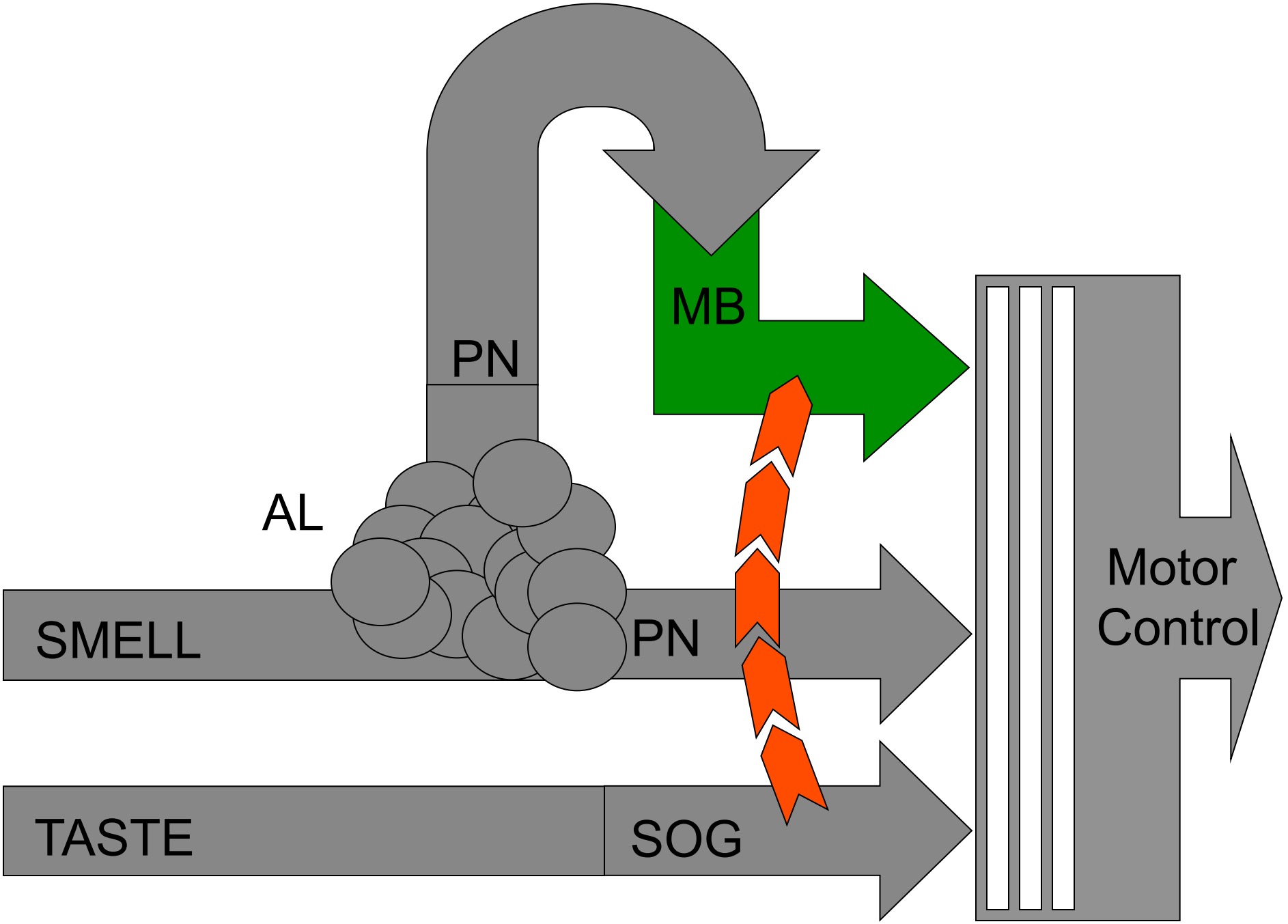


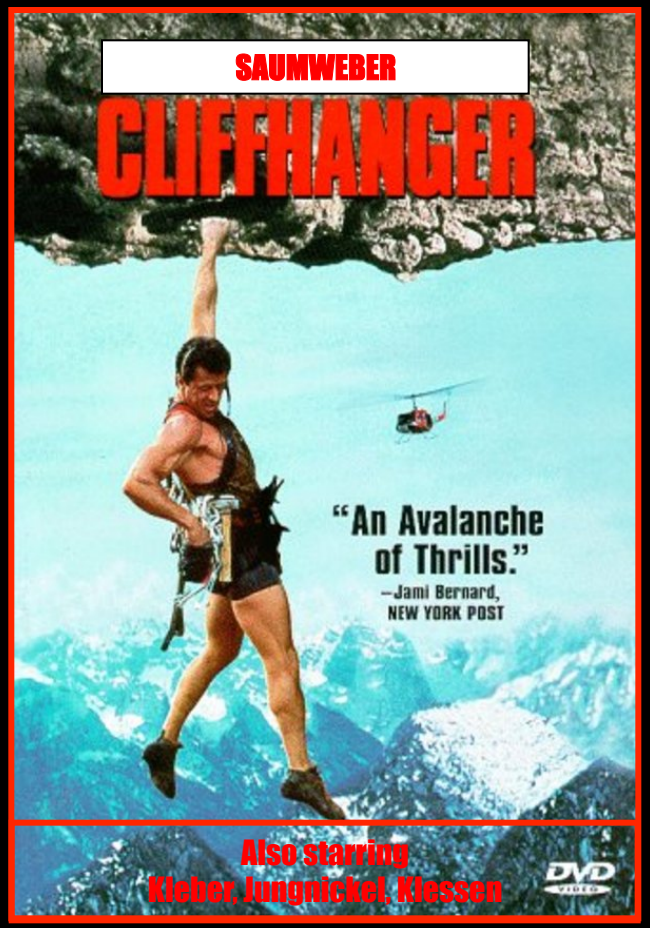


Learning impaired






PN
MB
AL
SMELL
PN
Motor
Control
TASTE
SOG


SAUMWEBER
CLIFFHANGER
"An Avalanche of Thrills."
–Jami Bernard, NEW YORK POST
Also starring
Kleber Jungnickel Klessen
DVD

LIN