What the mouse glomerulus tells the mouse brain
Olfactory epithelium

Olfactory bulb

Modified from the artwork of Graeme Lowe
$V_{\text{olfactory bulb}} \approx 5\% V_{\text{brain}}$
Olfactory receptors:

Human: ~ 350
Mouse: ~ 1200
olfactory receptors

olfactory epithelium

glomeruli

mitral cells

lateral olfactory tract

olfactory bulb

odorants

to olfactory cortex

Modified from the artwork of Graeme Lowe
Odorant-Evoked SpH Signals in the Mouse Olfactory Bulb

Bozza et al., Neuron, 2004
olfactory coding schemes
olfactory coding schemes

1

2

3

vs
olfactory coding schemes

1

2

3

vs

time

sniff cycle
olfactory coding schemes

1 vs 2

3
olfactory coding schemes

1

2

3

sniff cycle

exhalation

inhalation

time
Optogenetic approach

G. Nagel, D. Ollig, M. Fuhrmann, S. Kateriya, A.M. Musti, E. Bamberg, P. Hegemann
*Channelrhodopsin-1: A Light-Gated Proton Channel in Green Algae*
Science, 296, 28 (2002)

G. Nagel, T. Szellas, W. Huhn, S. Kateriya, N. Adeishvili, P. Berthold, D. Ollig, P. Hegemann, E. Bamberg
*Channelrhodopsin-2, a directly light-gated cation-selective membrane channel*

E.S. Boyden, F. Zhang, E. Bamberg, G. Nagel, K. Deisseroth
*Millisecound-timescale, genetically targeted optical control of neural activity*
Nature Neuroscience, 8 (9) 2005

Temporally precise, noninvasive control of activity in well defined neuronal populations is a long-sought goal of systems neuroscience.
response
stimulus
odor
delivery
blue light
mask
laser
pulse
licks
water
delivery

P
diode laser

odor
delivery
laser pulse:
40 mW - 1 ms

fraction correct
odor detection

consecutive sessions
0.5
0.6
0.7
0.8
0.9
1.0

ChR2 stimulation
control stimulation

laser pulse:
40 mW - 1 ms
light pulse: 1 ms

fraction correct

good

no-go

power (mW)

0.3 mW  3 mW  30 mW

1 ms
The diagram illustrates the relationship between the fraction correct and the power ratio in a go-no-go task. The diagram shows different power levels for go and no-go conditions, with the power ratios increasing from 1 to 16. The graph plots fraction correct against power ratio, with markers indicating the performance at various power levels. The data points suggest a positive correlation between power ratio and fraction correct, indicating improved performance with higher power levels.
The diagram illustrates the relationship between latency difference (ms) and fraction correct. The x-axis represents the latency difference (ms) ranging from 0 to 100 ms. The y-axis represents the fraction correct ranging from 0.5 to 1.0. The graph shows two lines, one for go and one for no-go, with different markers for each condition. The colors correspond to different conditions: red for go, green for no-go, orange for 25 ms, yellow for 15 ms, and blue for 100 ms. The diagram visually compares the performance across these conditions.
M72-ChR2-YFP
Inhalation

Time (ms)

Spikes/sec

Ethyl Tiglate

4-MethoxyAcetophenone

Inhalation

Diode laser

Sniff

Odor

Light

Time (ms)
Inhalation

\[ t_{sp} = f(\text{affinity}) \]