国際総合科学・基盤科学

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物質機能科学**IIb**

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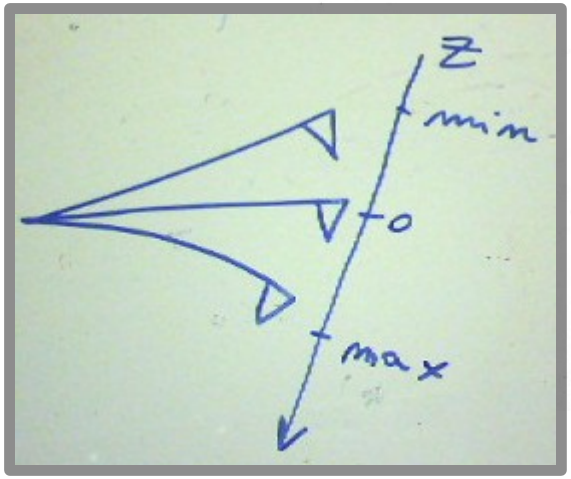
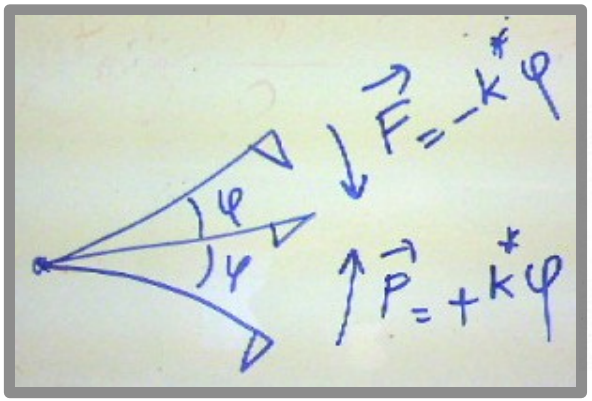
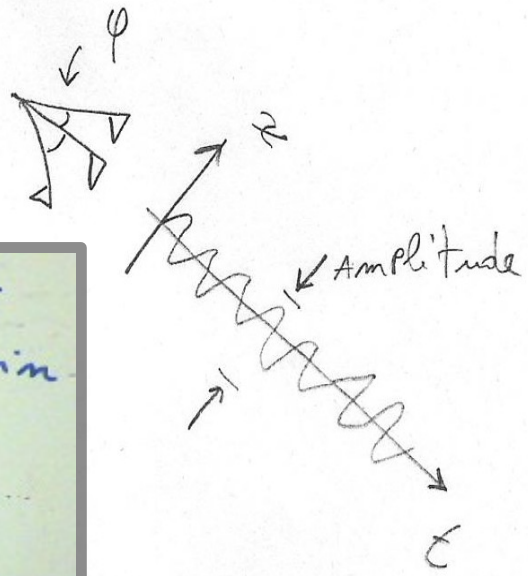
(6-7)

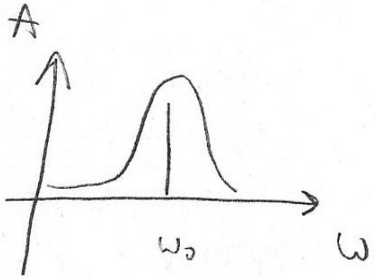
後期２００９年

The cantilever vibration Physics:









$$\vec{F} = -k^* \Delta\varphi$$

$$m \frac{d^2 z}{dt^2} = -k^* d\varphi$$

$$m \int \frac{d^2 z}{dt^2} = -k \int d\varphi$$

$$dz = l\,d\varphi$$

$$z = l * \sin(\alpha) \simeq z = l * \alpha$$

$$m\,l\,\frac{d^2\varphi}{dt^2} = -k\,d\varphi$$

$$m\,l\,\ddot{\varphi} = -k\varphi$$

$$\boxed{m\,l\,\ddot{\varphi} + k\varphi = 0}$$

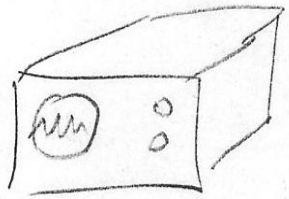
WAVE EQUATION → SOLUTION

$$\boxed{\ddot{\varphi} + \frac{k}{m\,l}\varphi = 0}$$

$$\begin{cases} \varphi(t) = A\sin(\omega_0 t) \\ \omega_0^2 = \dfrac{k}{m\,l} \end{cases}$$

How to measure the cantilever Force:

① OBSERVE ω_0 on oscilloscope



$\Rightarrow \omega_0 \Rightarrow f_0 = \frac{\omega_0}{2\pi}$

$$k^* = m l \omega_0^2 = m l 2\pi f_0$$

$m = 0.01\,mg$

$f = 50\text{KHz}$

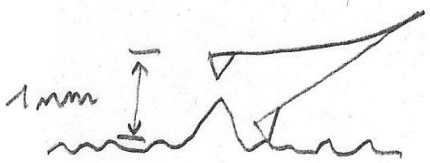
$l = 1\text{mm}$

$dz = 1\text{nm}$

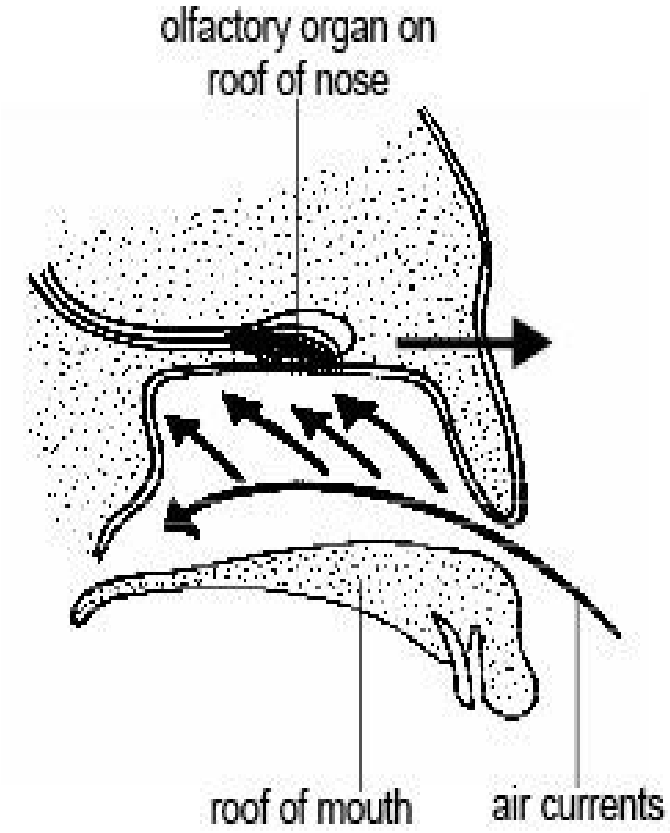
$F = ??$

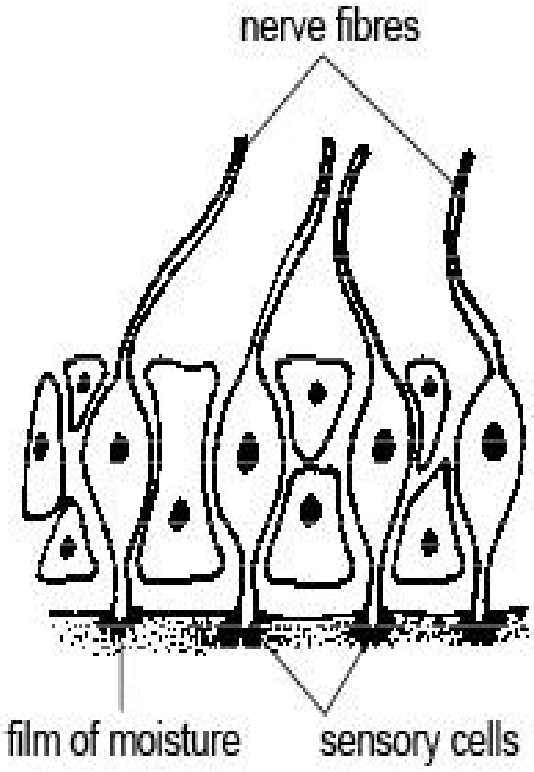
Suppose $\Delta z = 1\,mm = 1\,10^{-9}\,[m]$

$$\vec{F}_{(\text{over } 1mm)} = -k^* tg^{-1} \frac{10^{-9}}{l[m]}$$

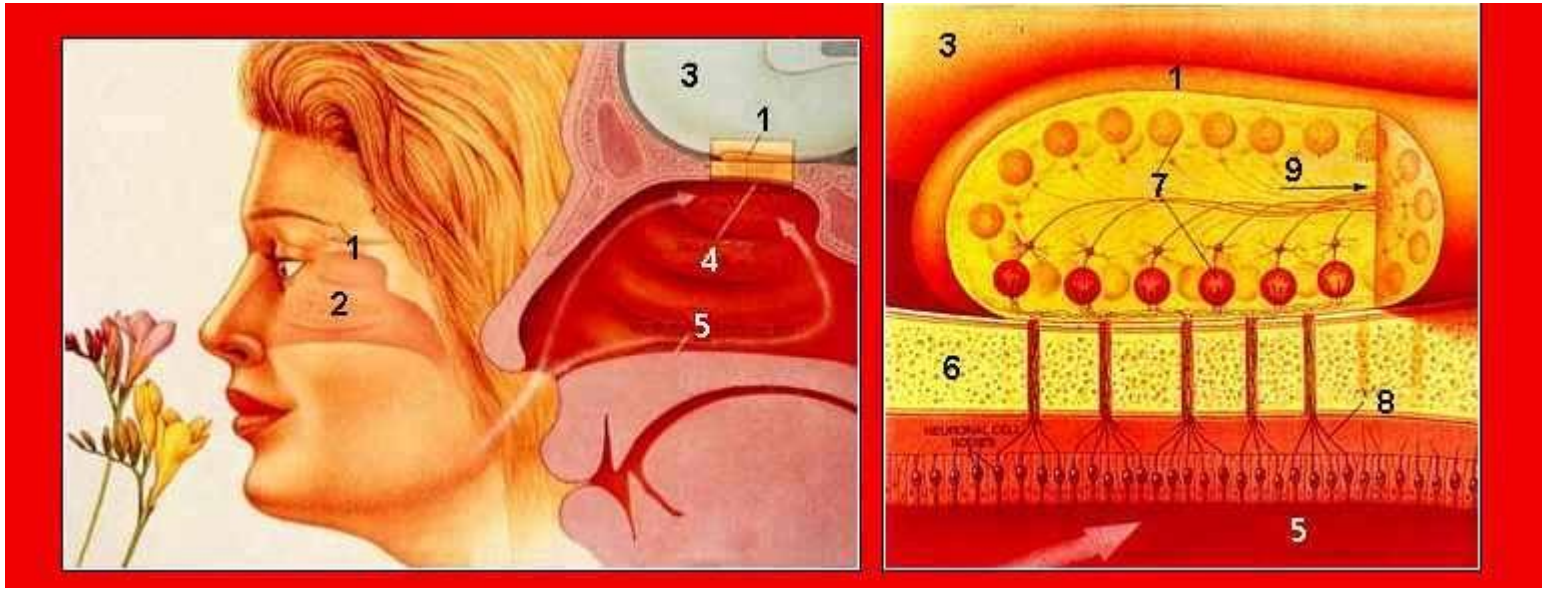


THE NOSE: the OLFACTORY sense　（嗅覚、きゅうかく）

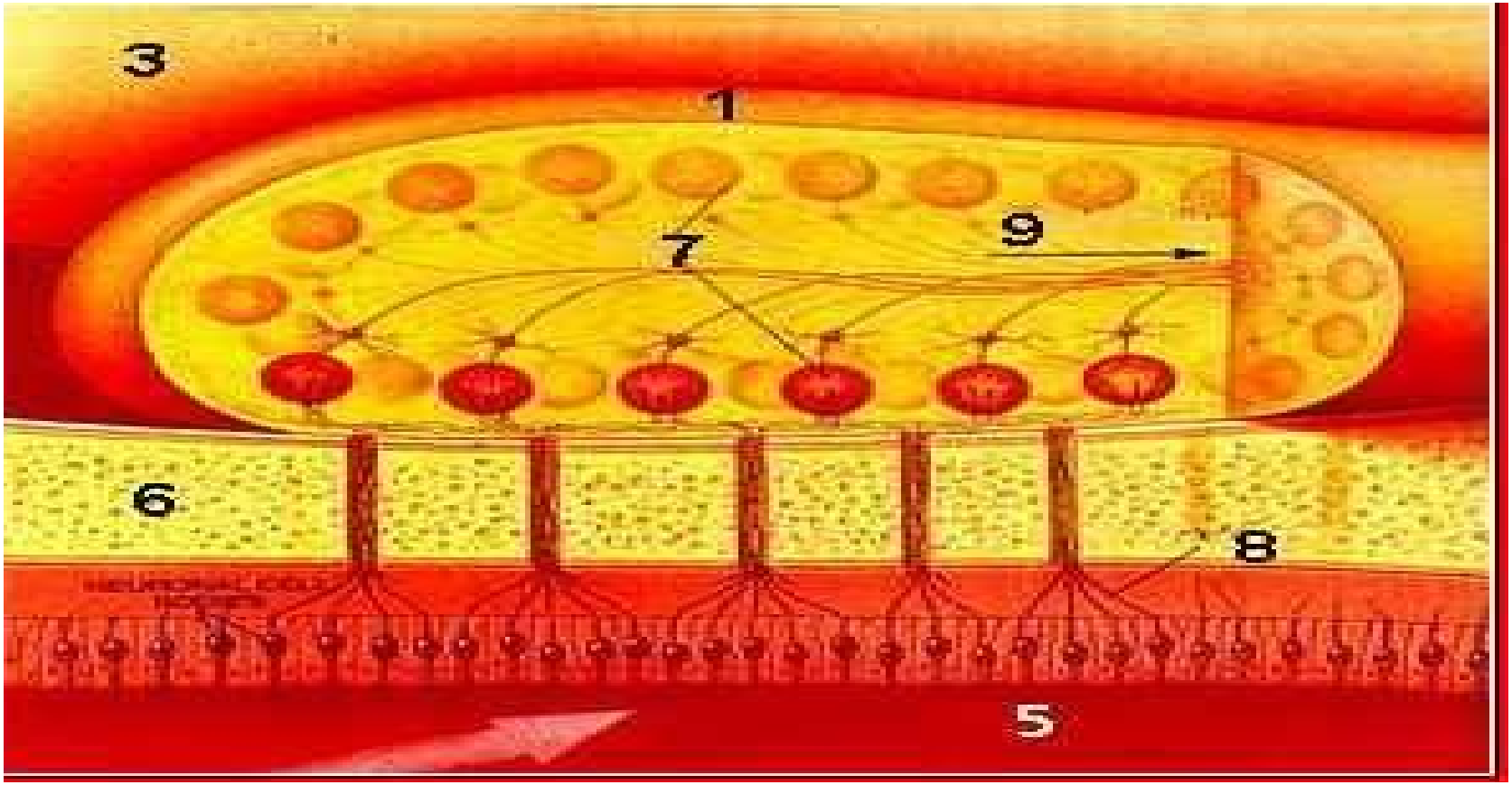




magnification of part of
olfactory organ



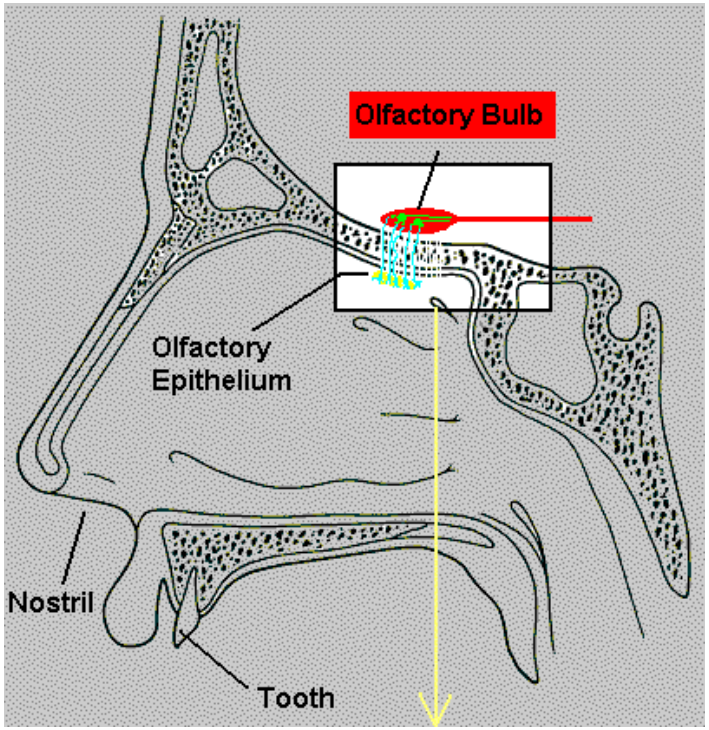
The olfactory sensors are located in yellow pigmented areas on each side of the inner nose. These areas are about 2.5 cm^2 in area each, and contain chemoreceptors, which are nerve cells responding to certain chemicals that are carried to the sensors as gases. The detailed functioning of these cells does not appear to be known.

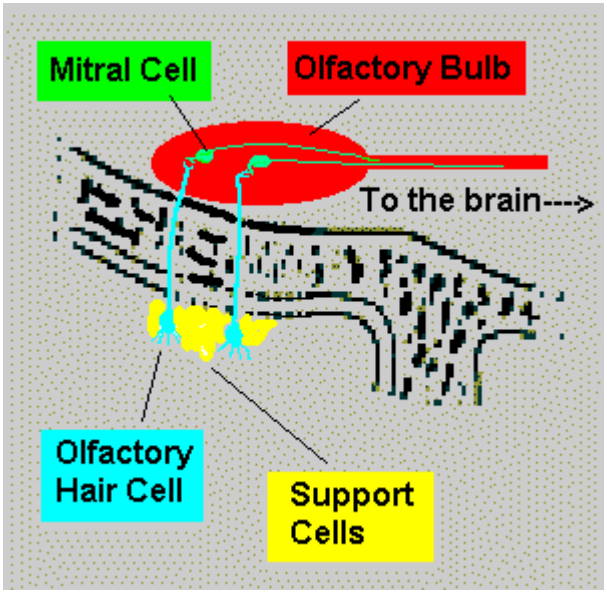


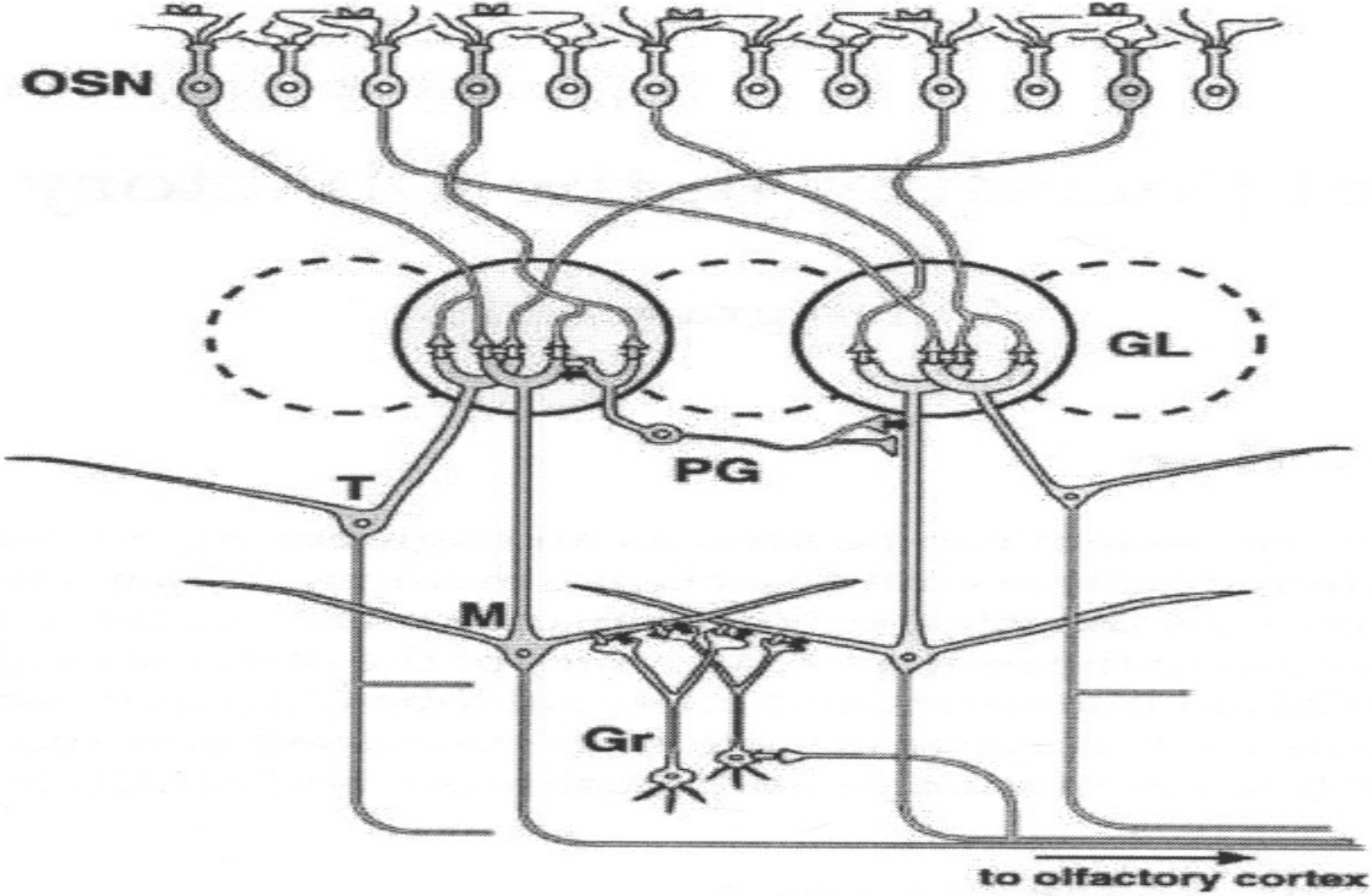
The glomeruli, each receiving signals from some 26 000 receptors. The olfactory bulbs on either side are cross-connected. Finally nerve fibres reach the olfactory areas in the anterior lobes of the brain.

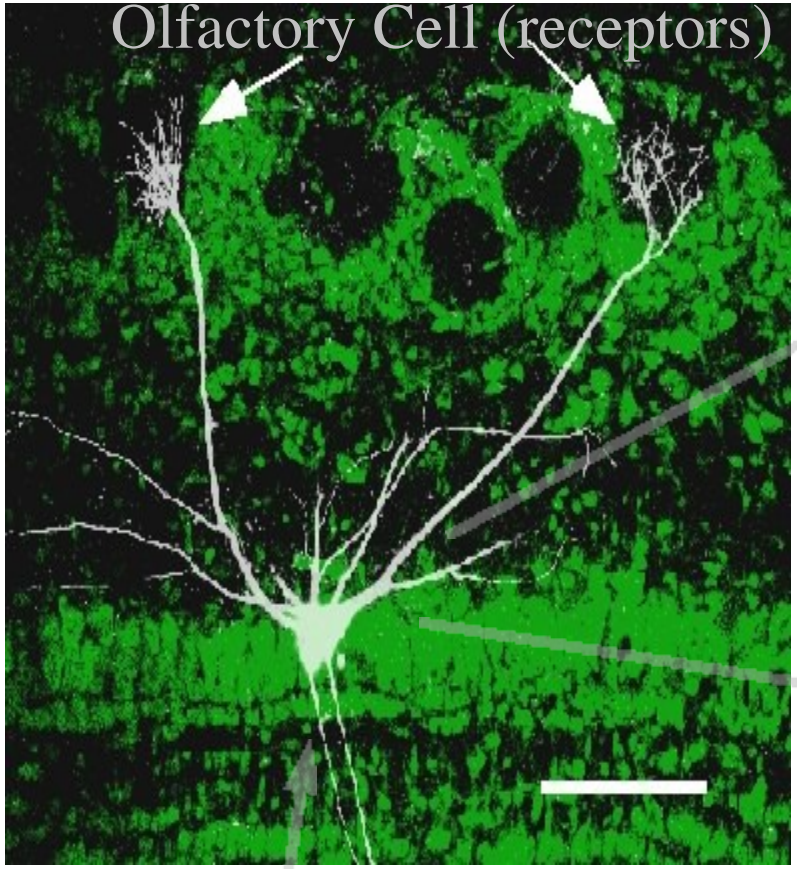
- The olfactory sense is some 10000 times as sensitive as taste, and is primarily responsible for the flavours of food.

- The types of olfactory sensations are 6: fruity, flowery, resinous, spicy, foul (rotten), and burned.



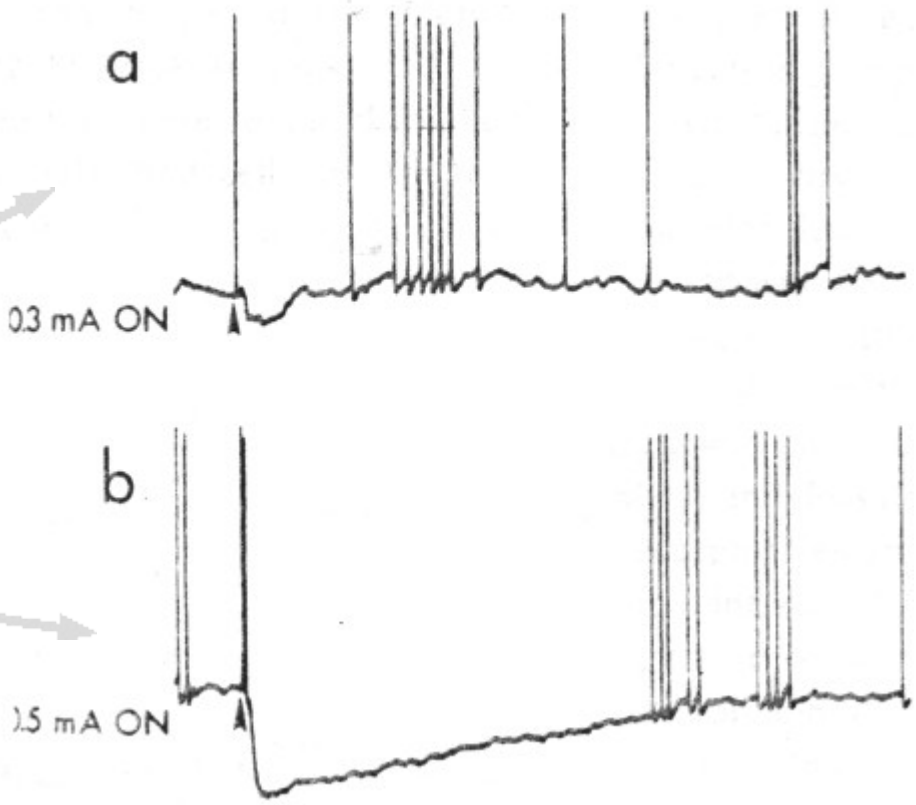



OSN
GL
PG
T
M
Gr
to olfactory cortex

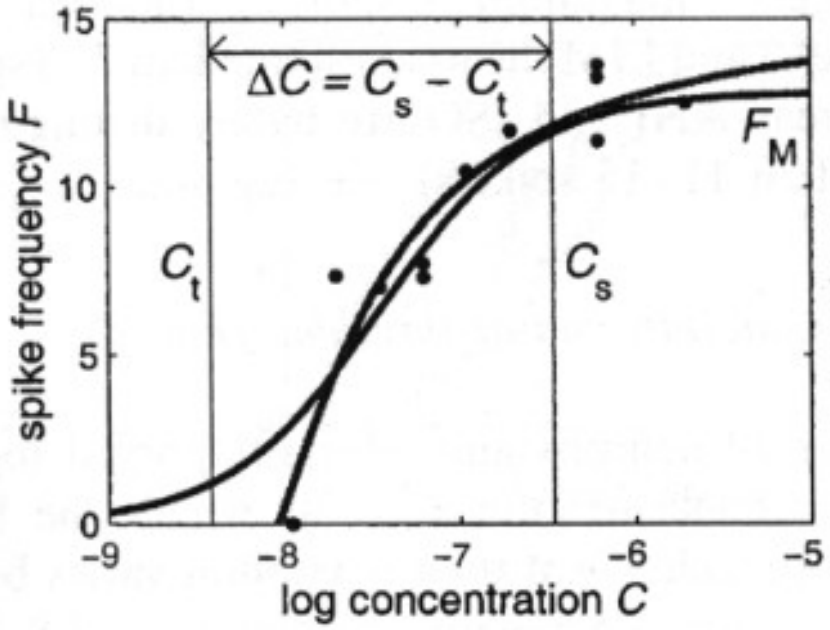


Mitral Cell

Signal from Mitral Cells

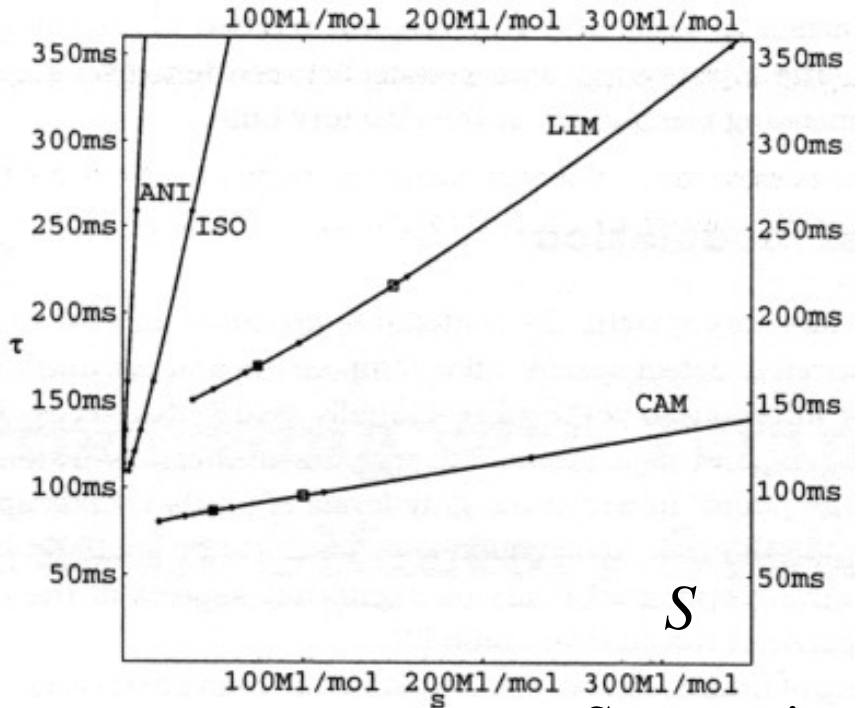


スパイク周波数



香科密度

スパイクの時間間隔



香科密度

S=sparsity

$$\tau = \tau_0 + Gs$$

$$\tau = \tau_0 + Gs$$

Gはガインといます。

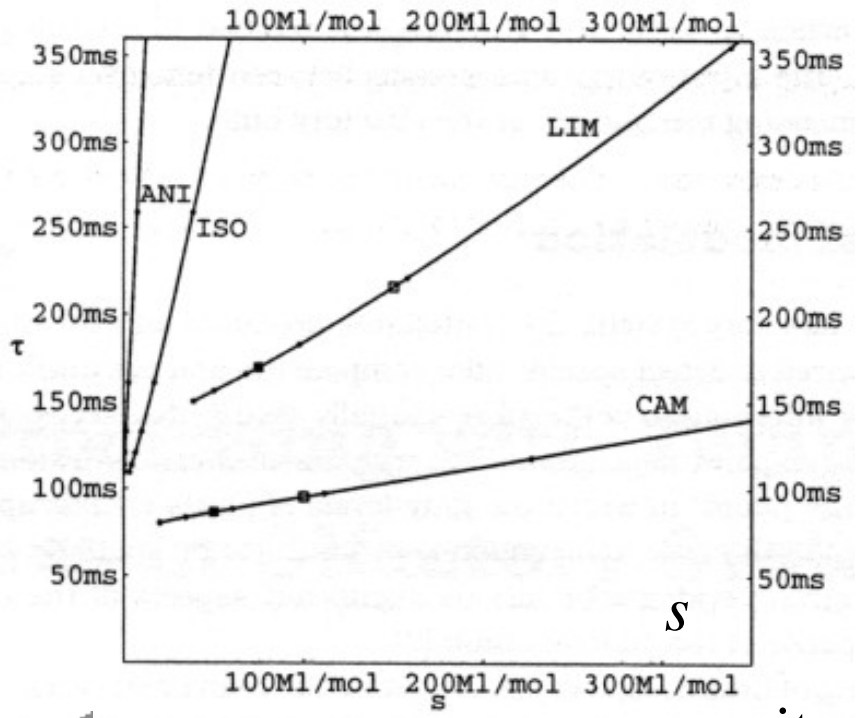
香科によってGは違います。

例：$G_{camphor}$=1.0

G_{lemon}=2.5

$G_{anisole}$=20

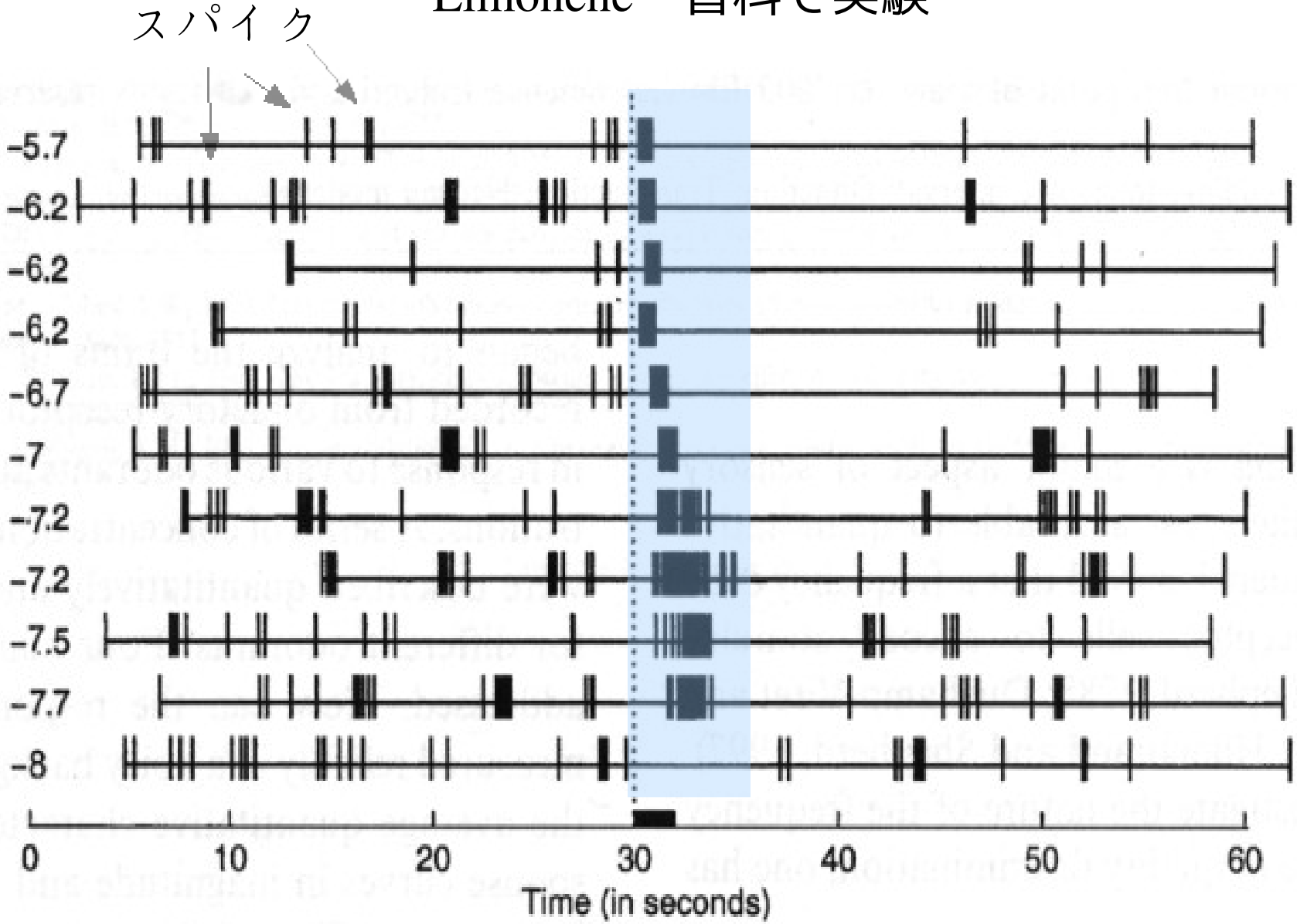
スパイクの時間間隔



香科密度

s=sparsity

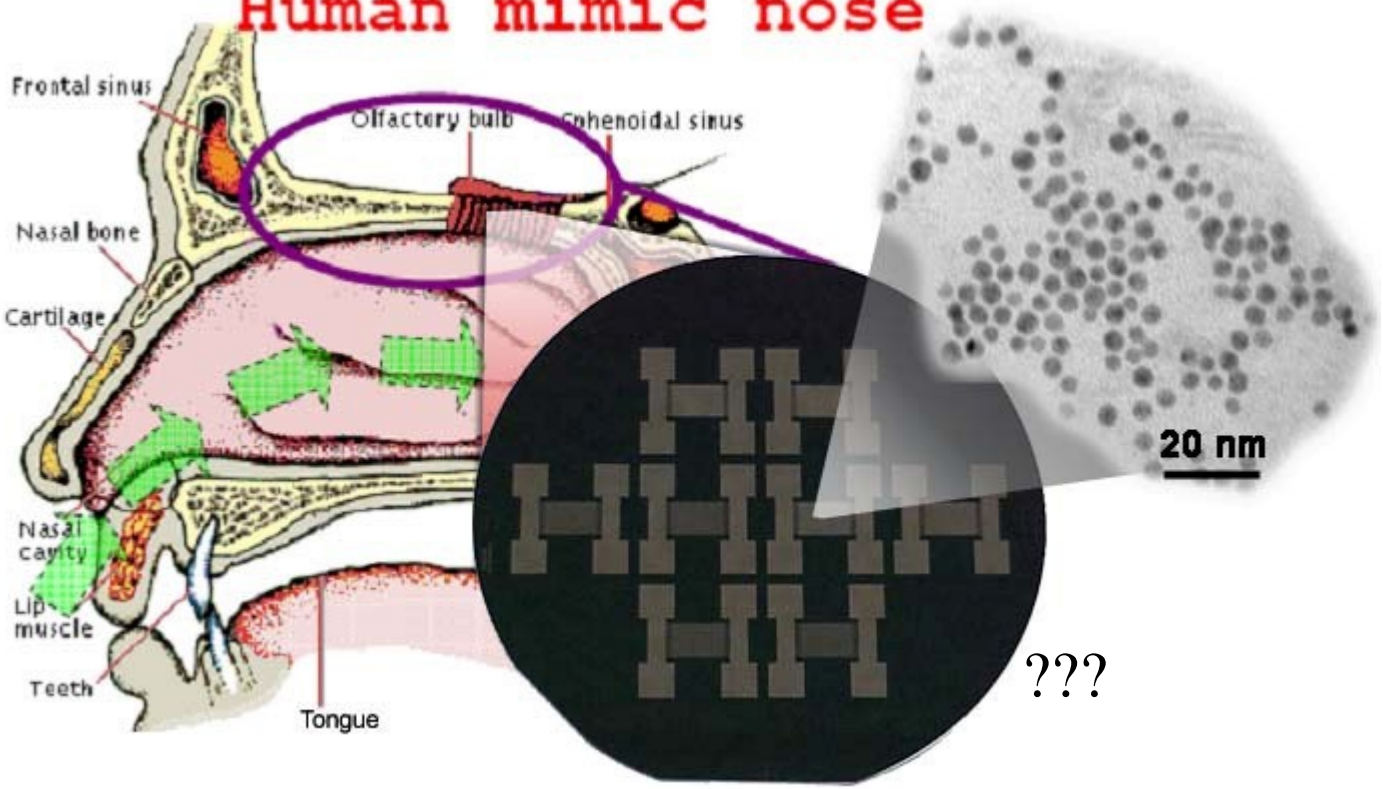
Limonene　香科で実験



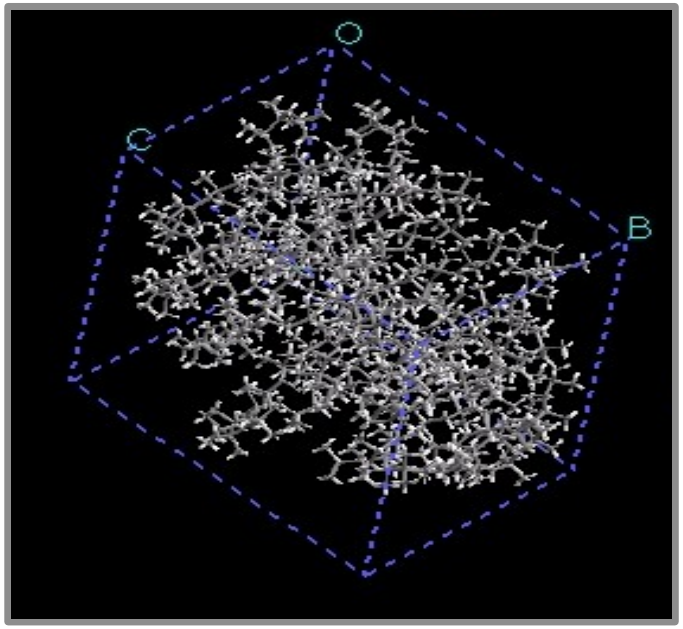
人工嗅覚

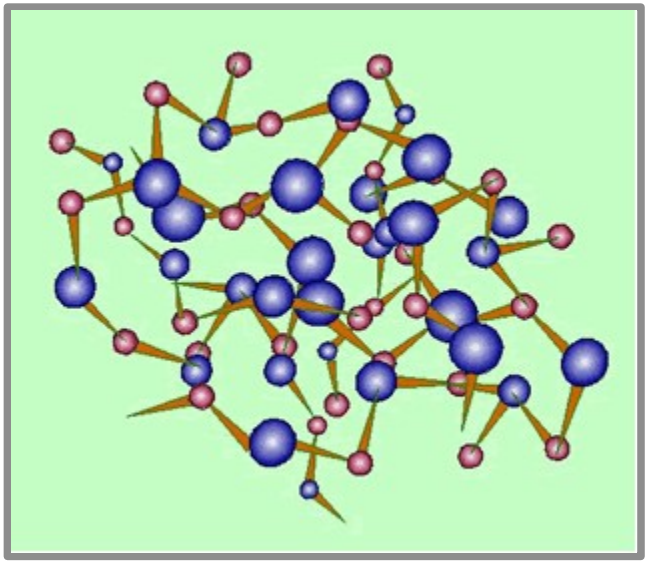
JPL 人工嗅覚デバイス

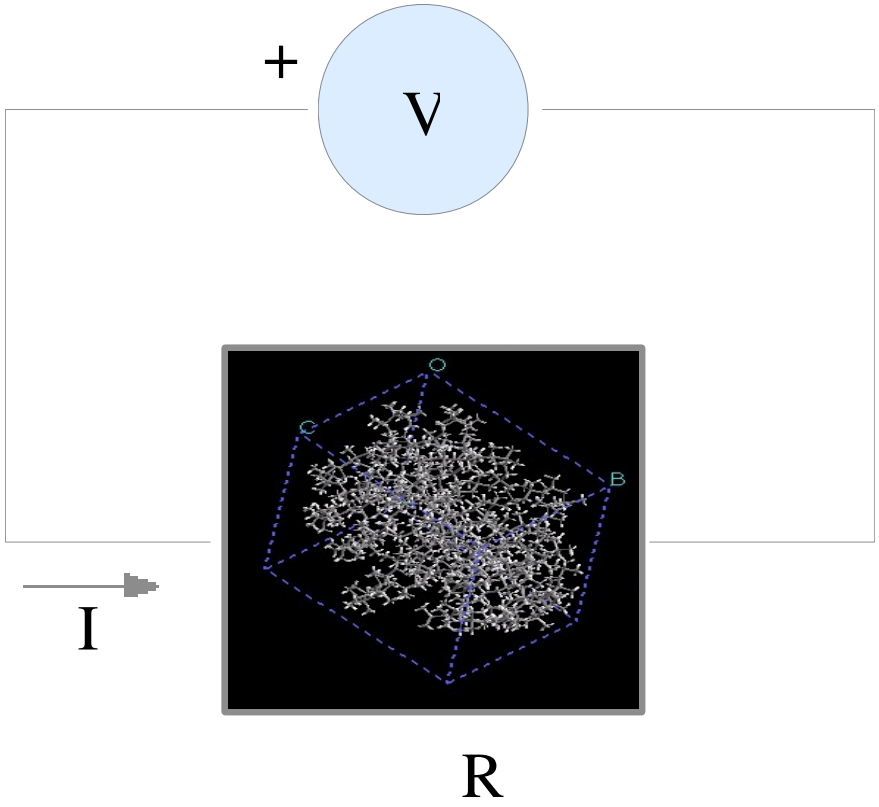
Human mimic nose



Polymers complex structure






+
V
O
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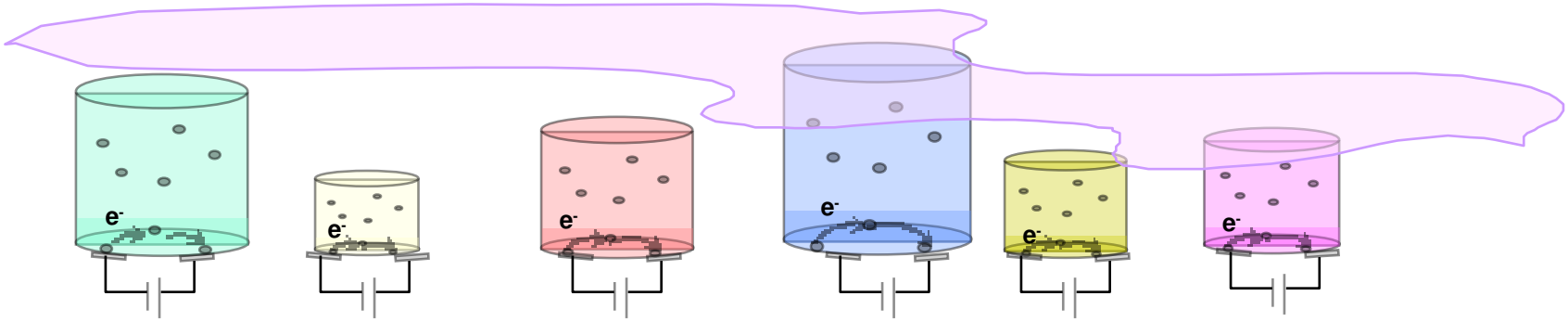
I
R

THE ELECTRONIC NOSE SMELLS SOMETHING

Each polymer changes its size, and therefore its resistance, by a different amount, making a pattern of the change



If a different compound had caused the air to change, the pattern of the polymer films' change would have been different:

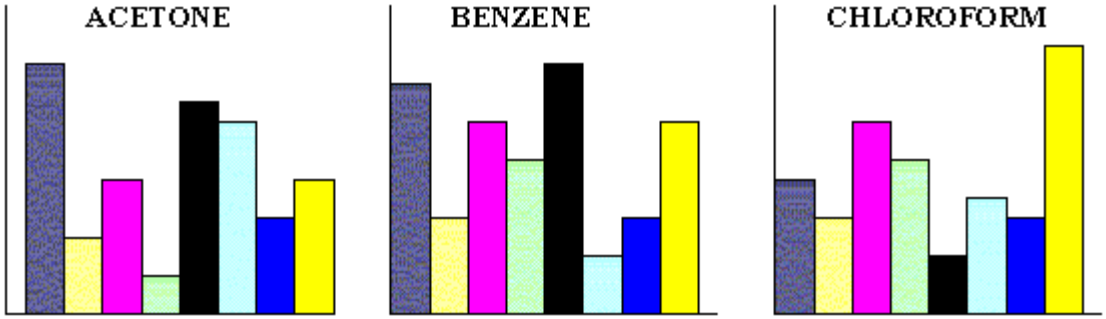
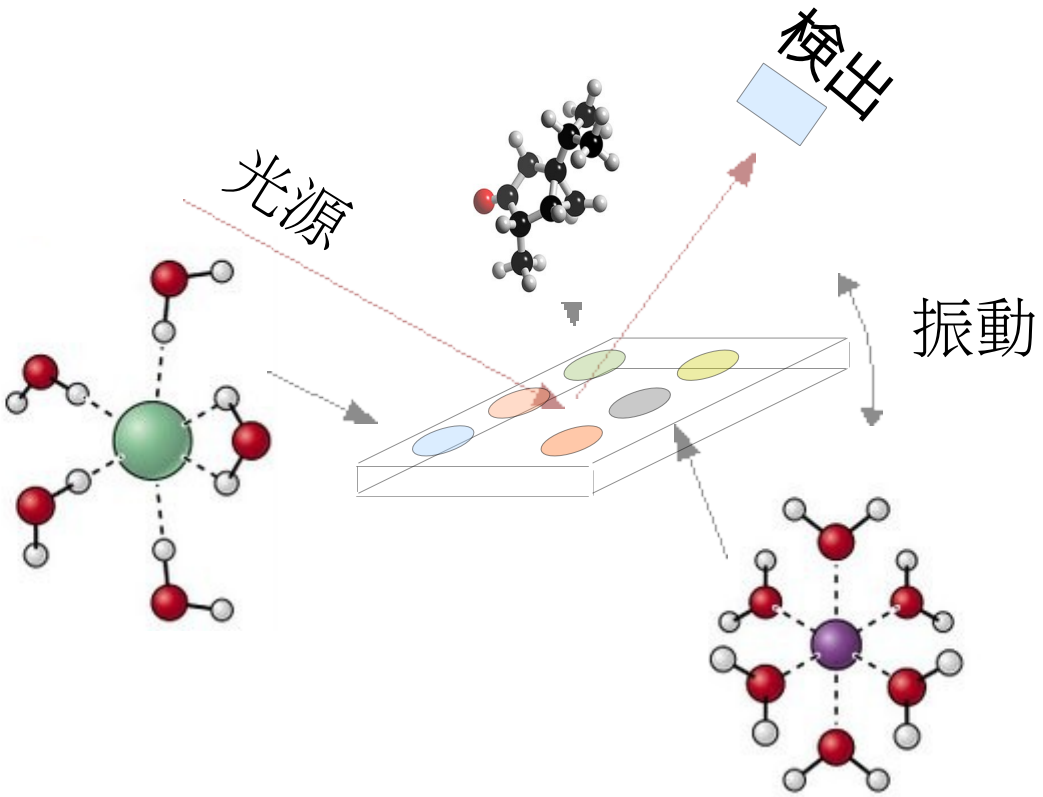
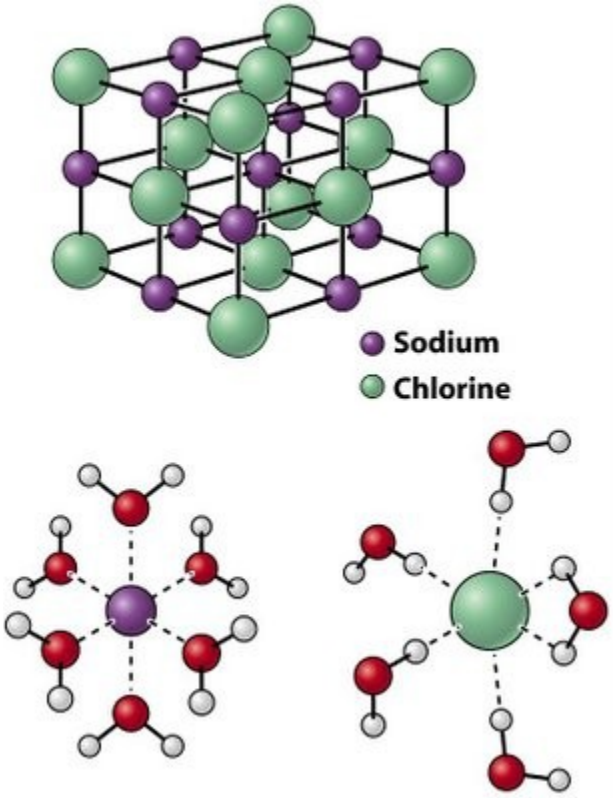


Figure 1.

AFM NOSE





結合する分子によって振動のパターンが異なる。