

# 動物の感覚

<http://www.biol.tsukuba.ac.jp/~nakatani/>

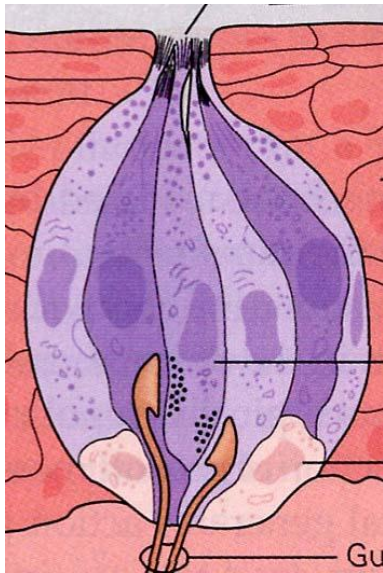
Password: sense

# 感覚とは？

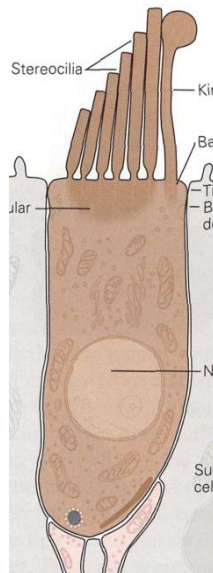




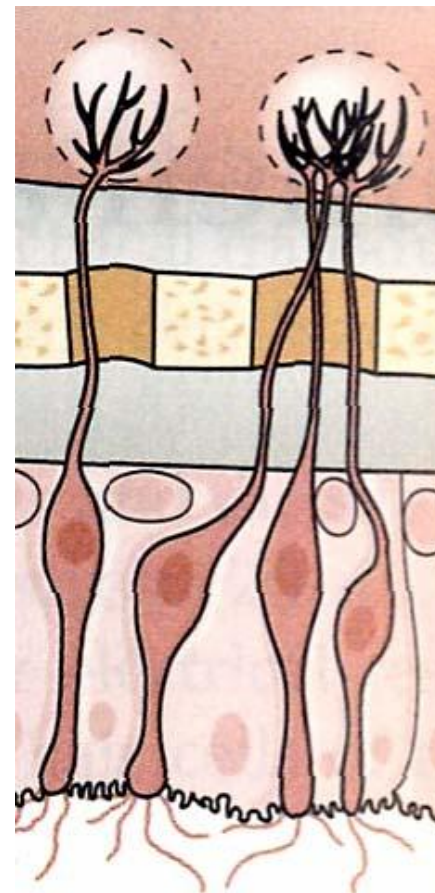
視細胞(視覺)



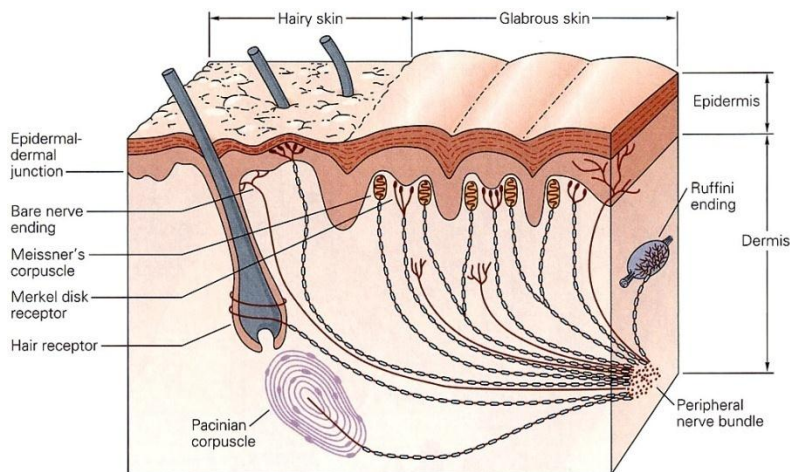
味細胞(味覺)



內耳有毛細胞  
(聽覺)

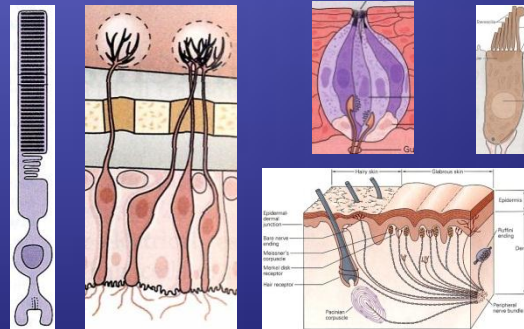
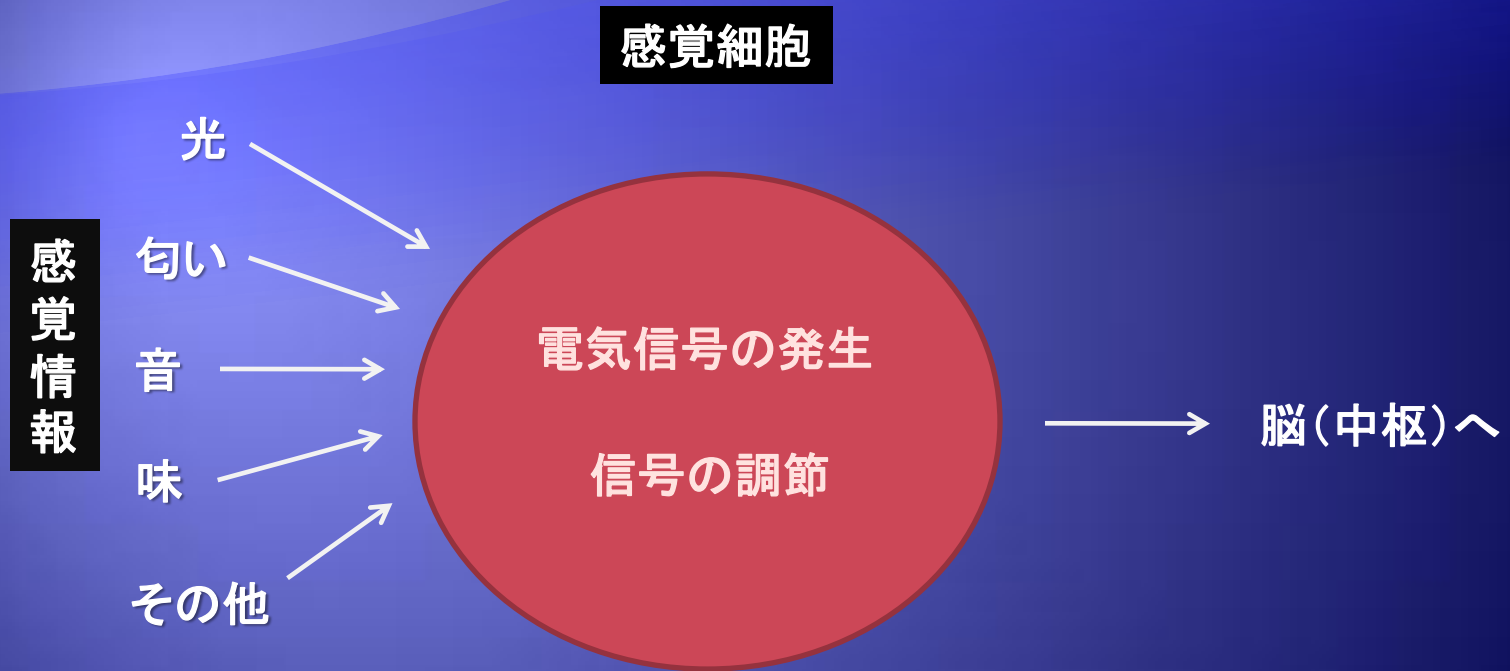


嗅細胞(味覺)



(体性感覺(觸覺, 痛覺, 溫覺, 冷覺, 他))

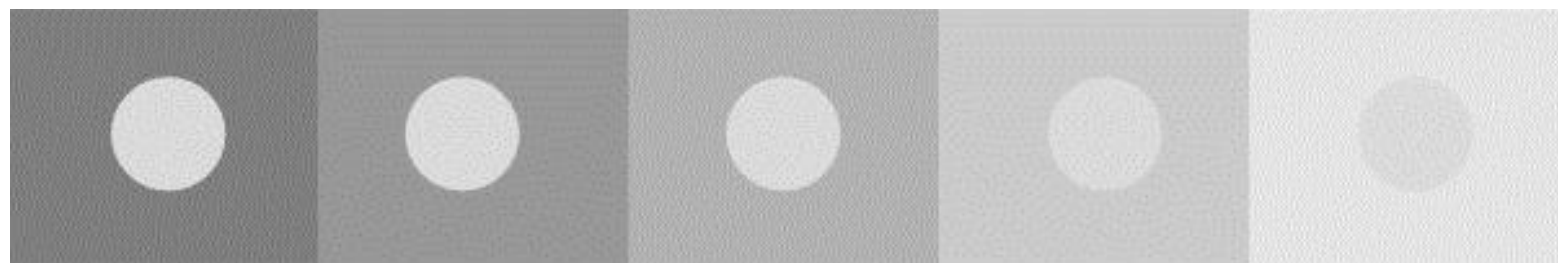
# 感覚細胞におけるシグナル伝達メカニズム

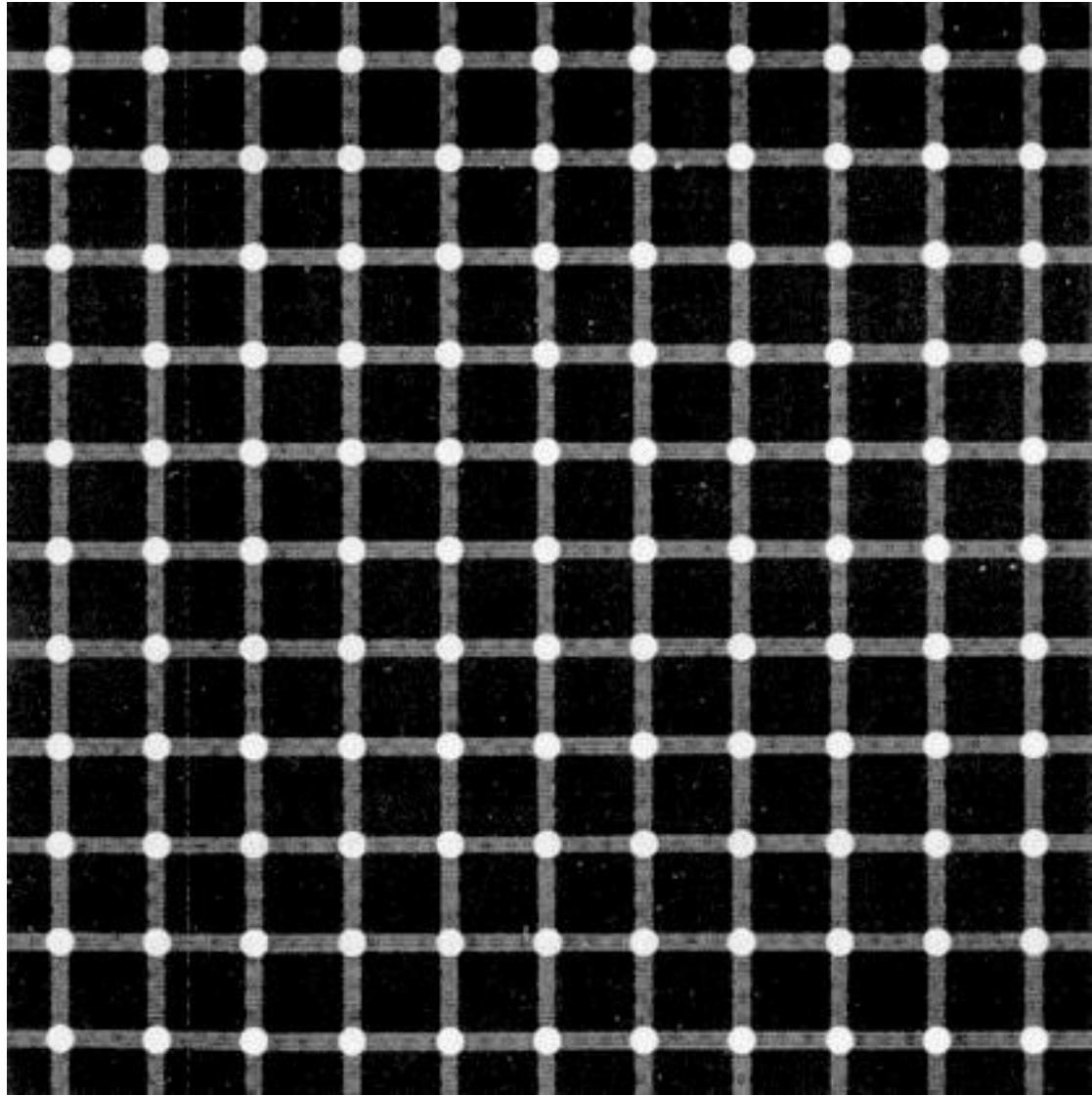


視 覚

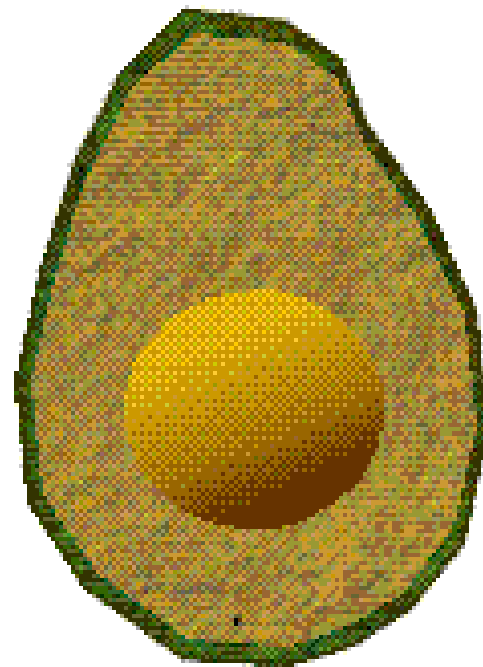
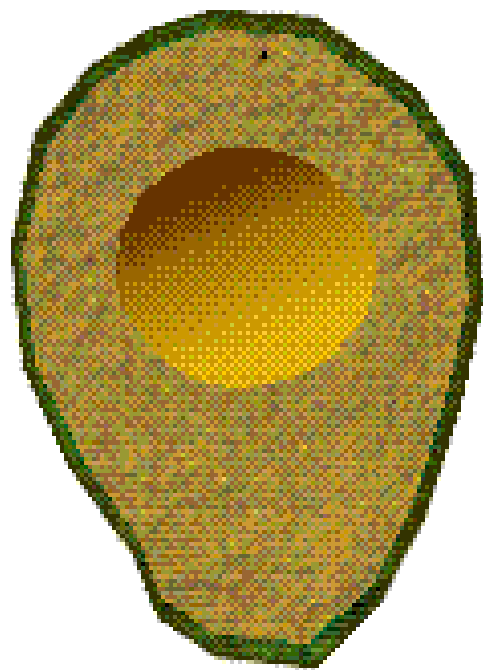
( Vision )



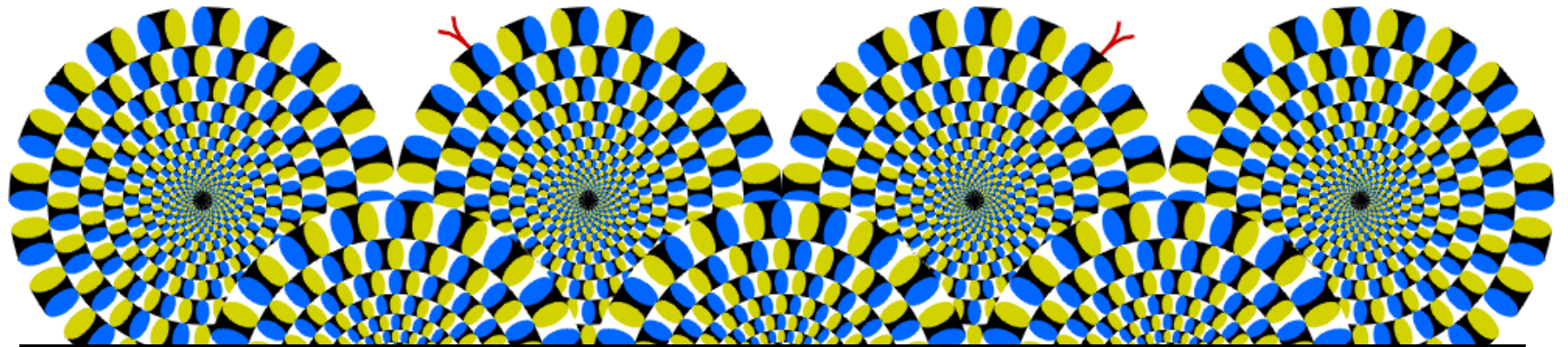








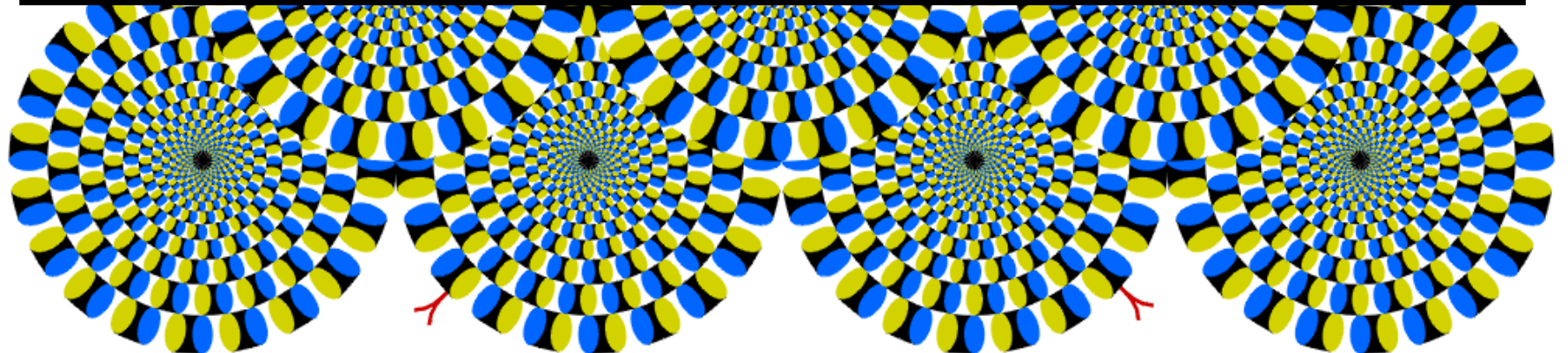




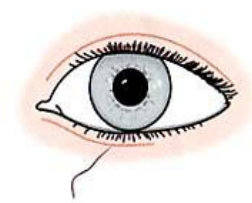
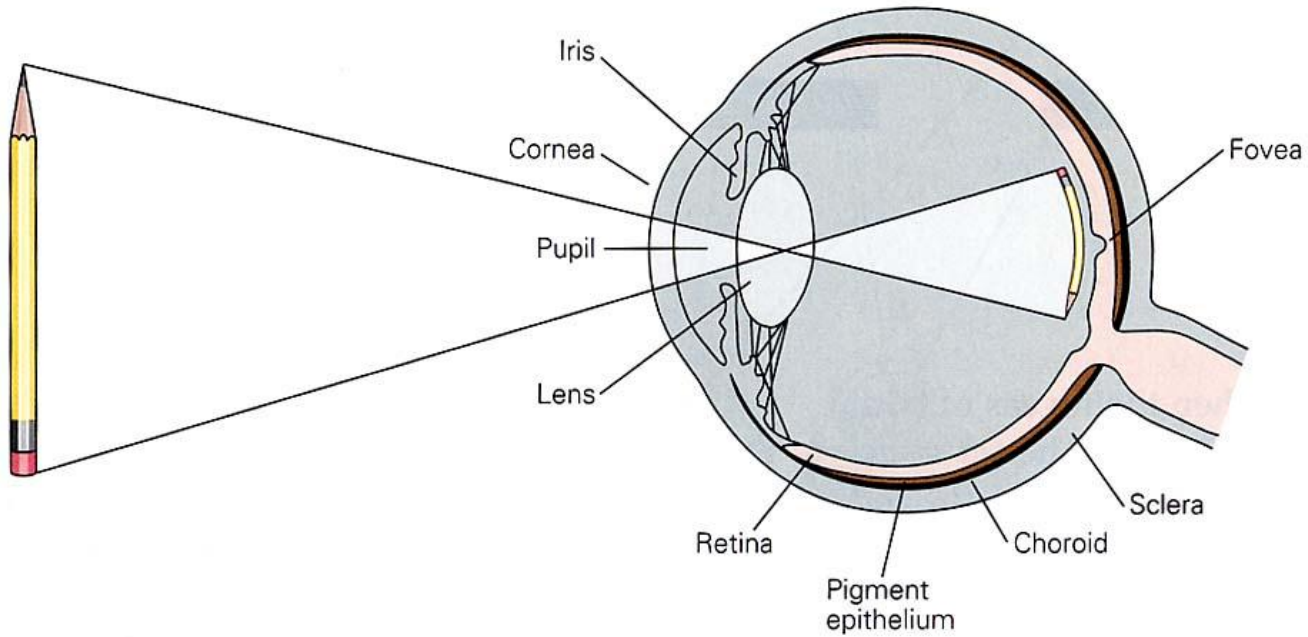
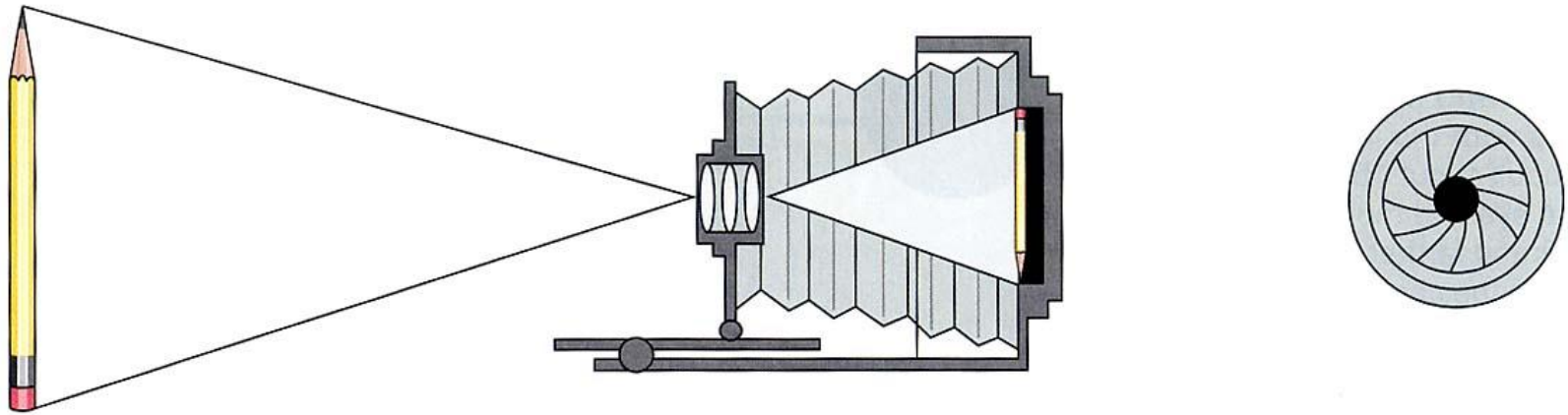
# The Joy of Visual Perception

- A Web Book -

<http://www.yorku.ca/eye/thejoy.htm>

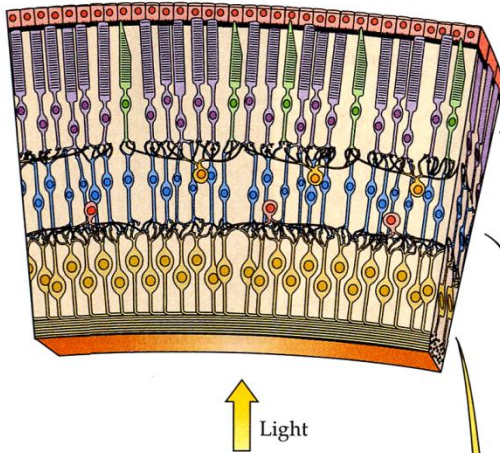


# 眼の構造

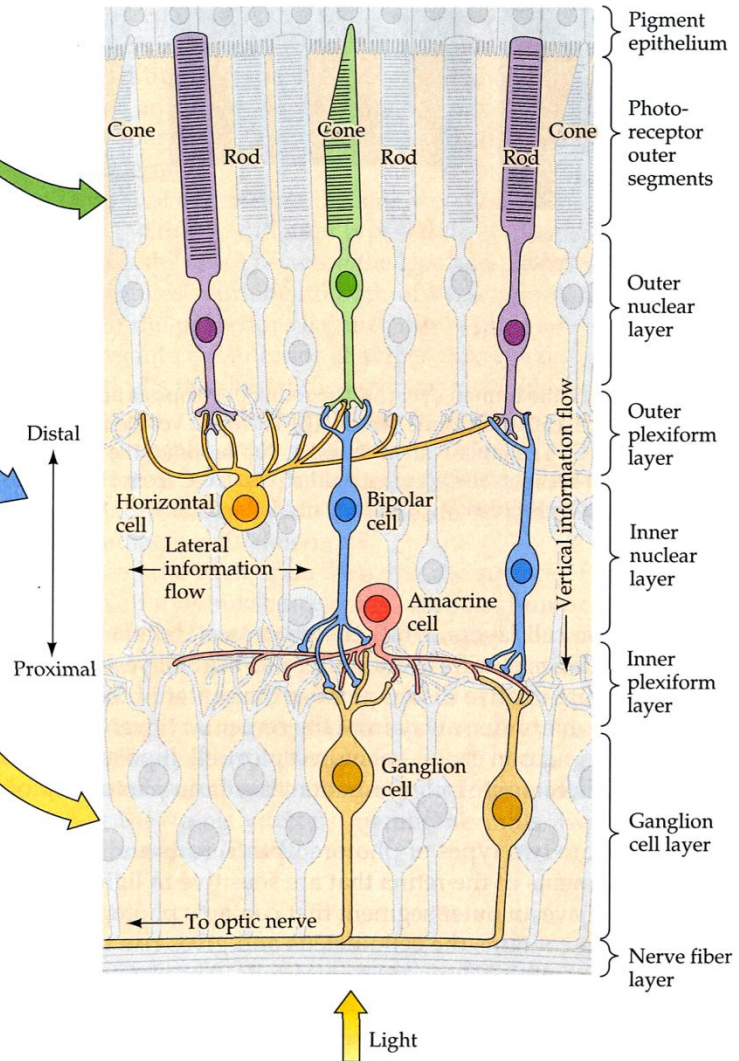


# ヒトの網膜

(A) Section of retina



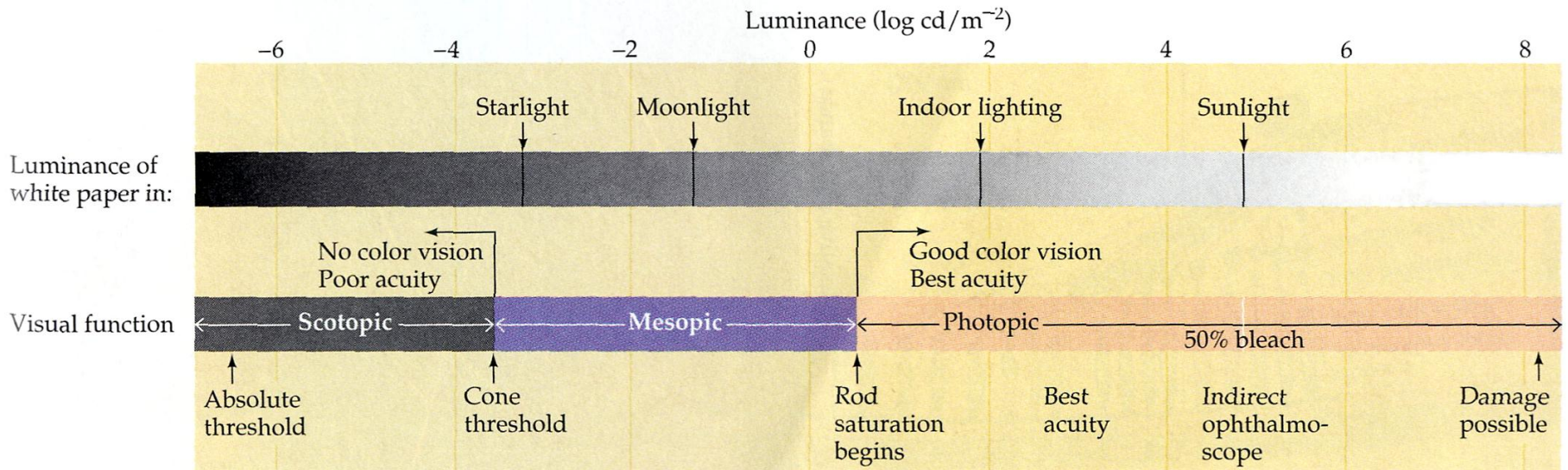
(B)



## 2種類の視細胞(ヒトの場合)

	桿体(系)	錐体(系)
光感度	高(暗い場所ではたらく)	低(昼間, 明るい場所ではたらく)
時間分解能	低(応答が遅い)	高(応答が速い)
視力	低(中心窩にない)	高(中心窩に集中)
色覚	無(1種類の細胞)	有(3種類の細胞) 青錐体 ( $\lambda_{\max} = 419 \text{ nm}$ ) 緑錐体 ( $\lambda_{\max} = 531 \text{ nm}$ ) 赤錐体 ( $\lambda_{\max} = 559 \text{ nm}$ )

# ヒはどれくらいの強さの光を見ることができるのか？



## 2種類の視細胞(ヒトの場合)

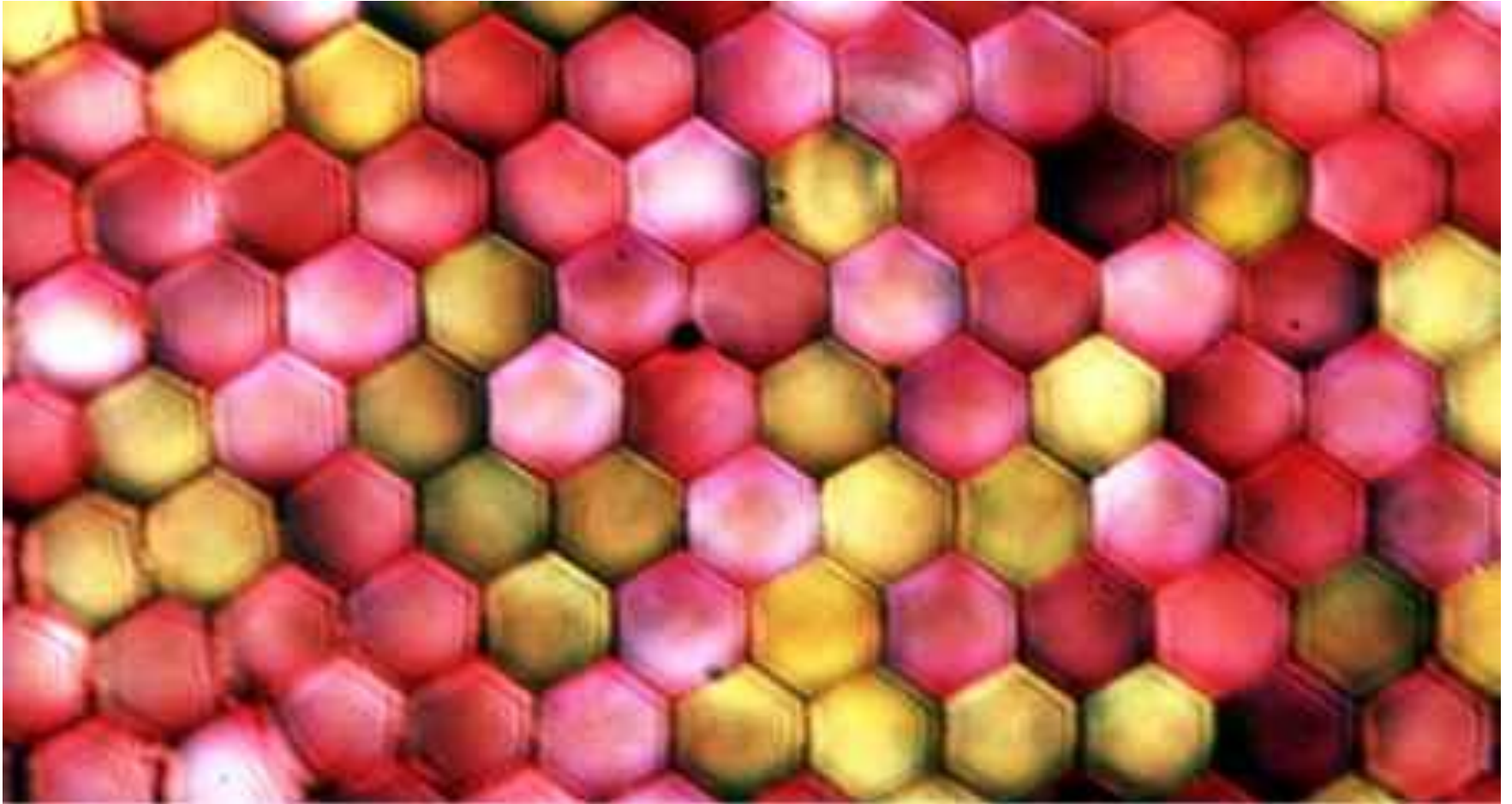
	桿体(系)	錐体(系)
光感度	高(暗い場所ではたらく)	低(昼間, 明るい場所ではたらく)
時間分解能	低(応答が遅い)	高(応答が速い)
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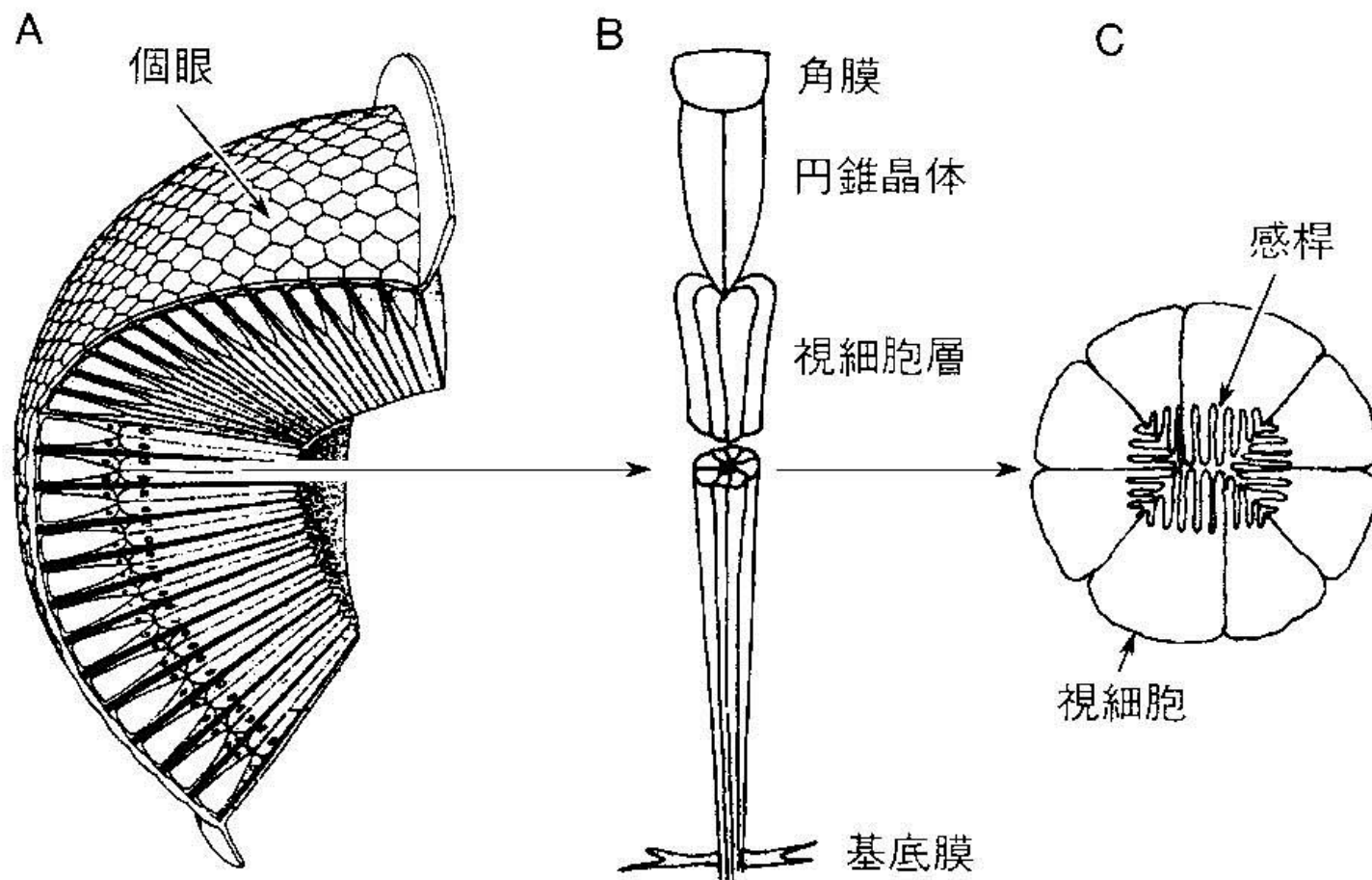
<http://studio-phiz.com/tsubu/>

## アゲハの複眼



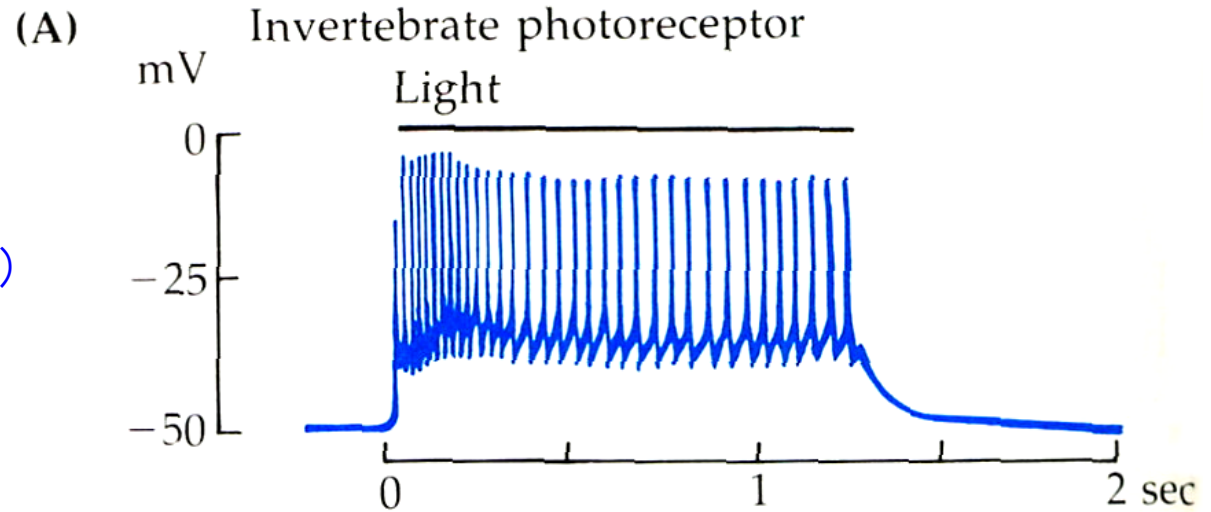
提供：蟻川 謙太郎 博士

## 複眼の模式図

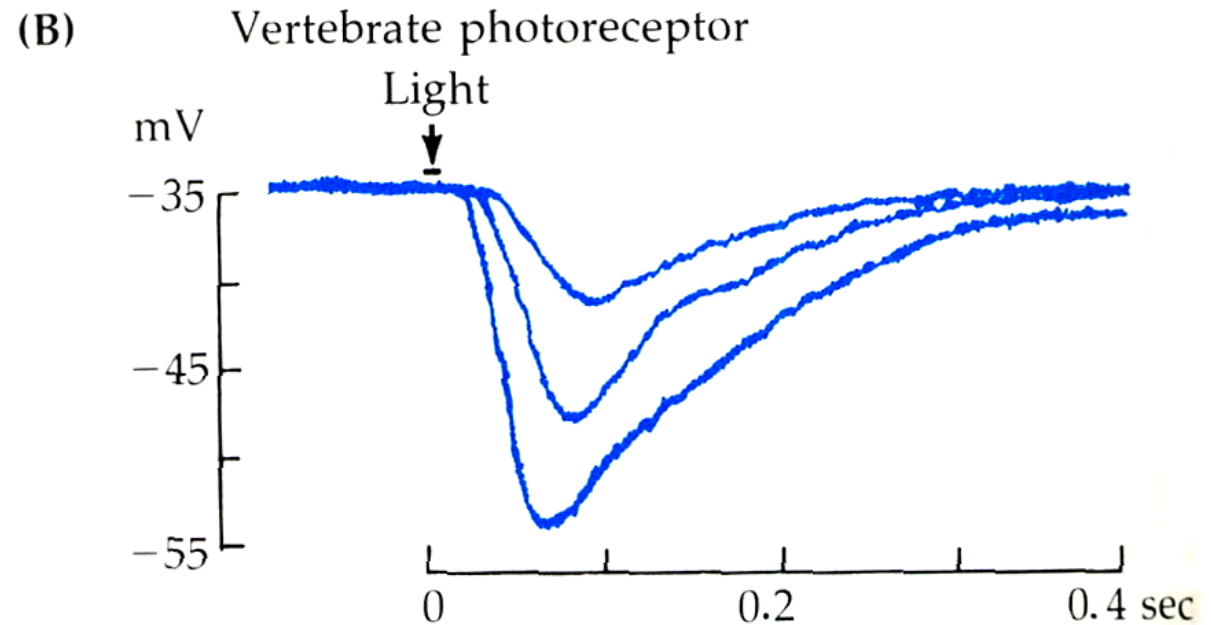


## 視細胞の光応答

無脊椎動物 (昆虫)



脊椎動物 (ヒト)



# 色覚

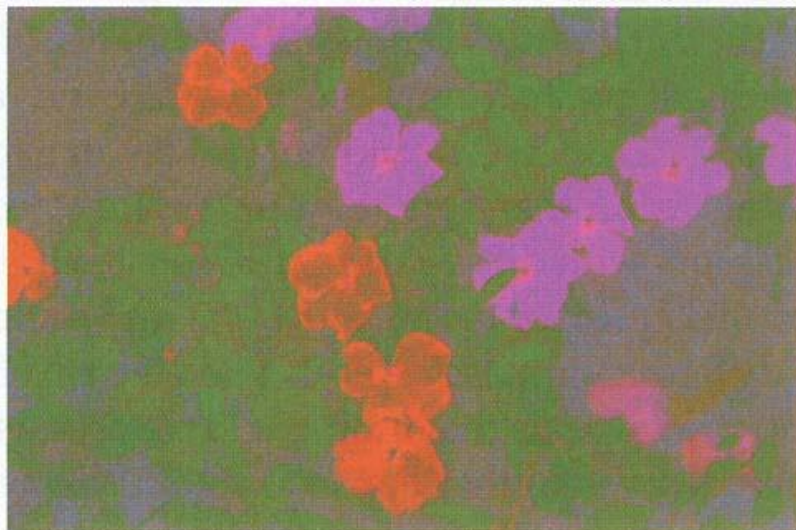
A Full color image

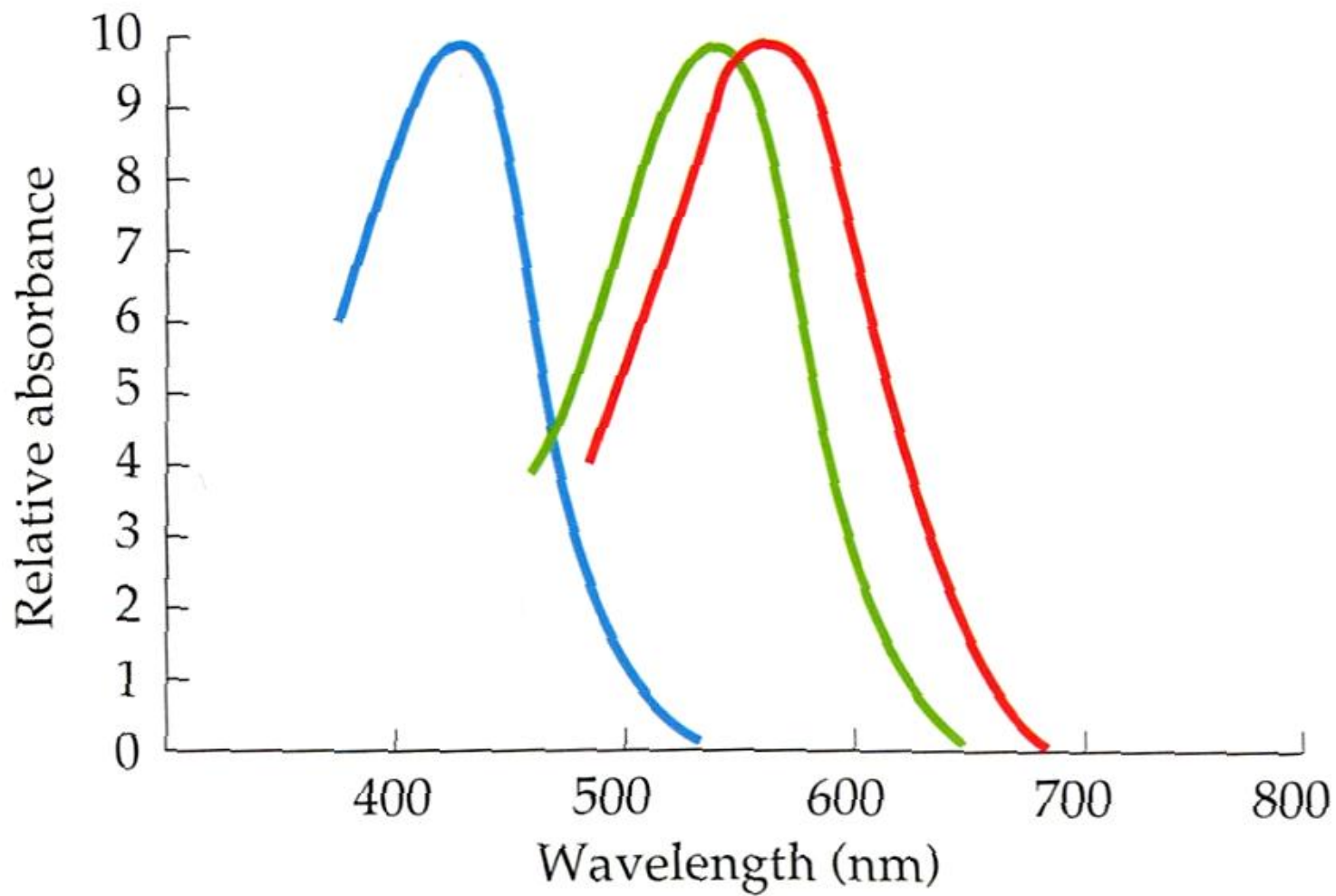


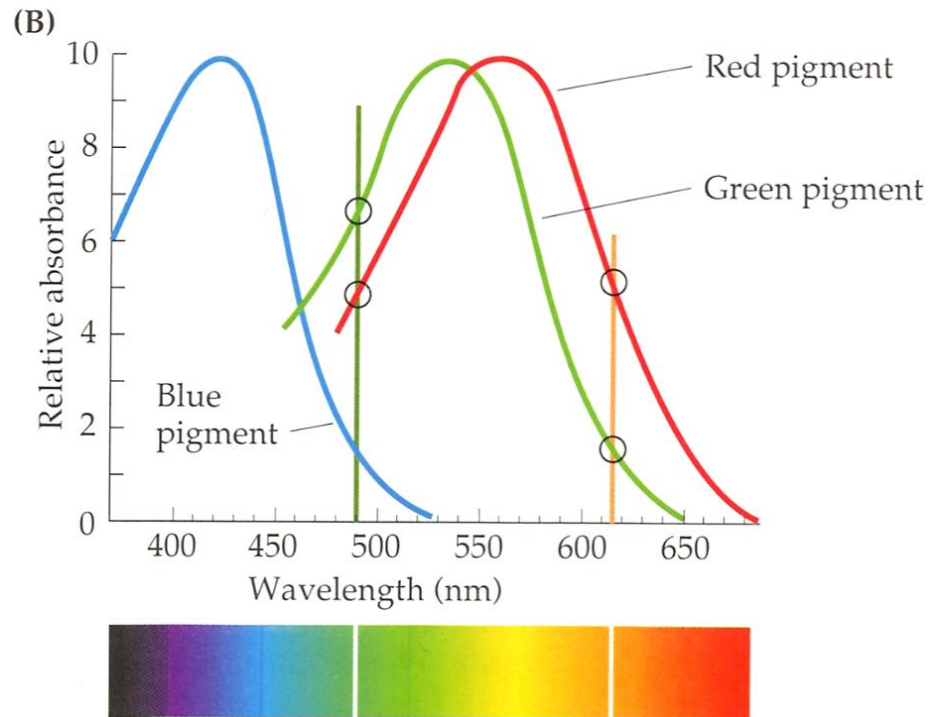
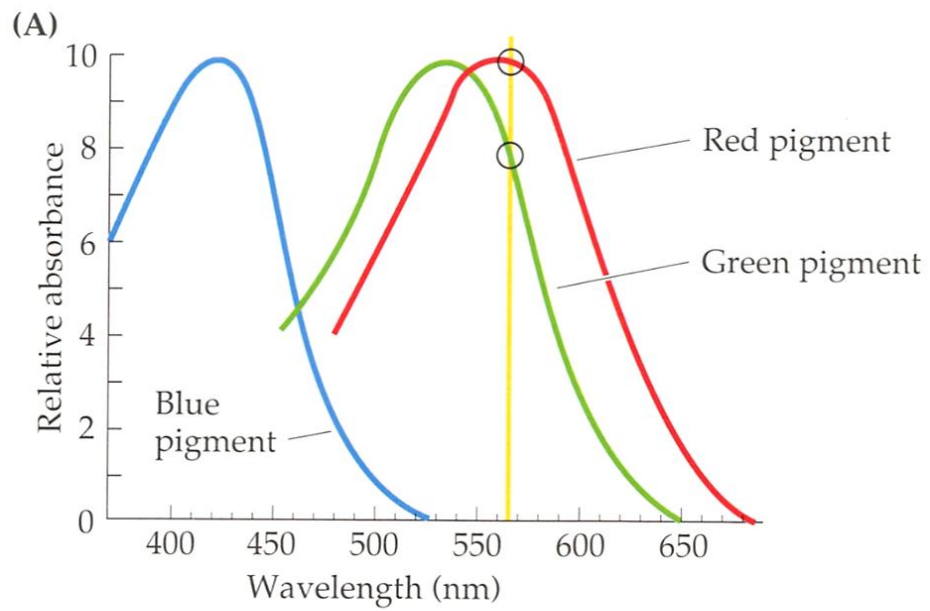
B Black and white only

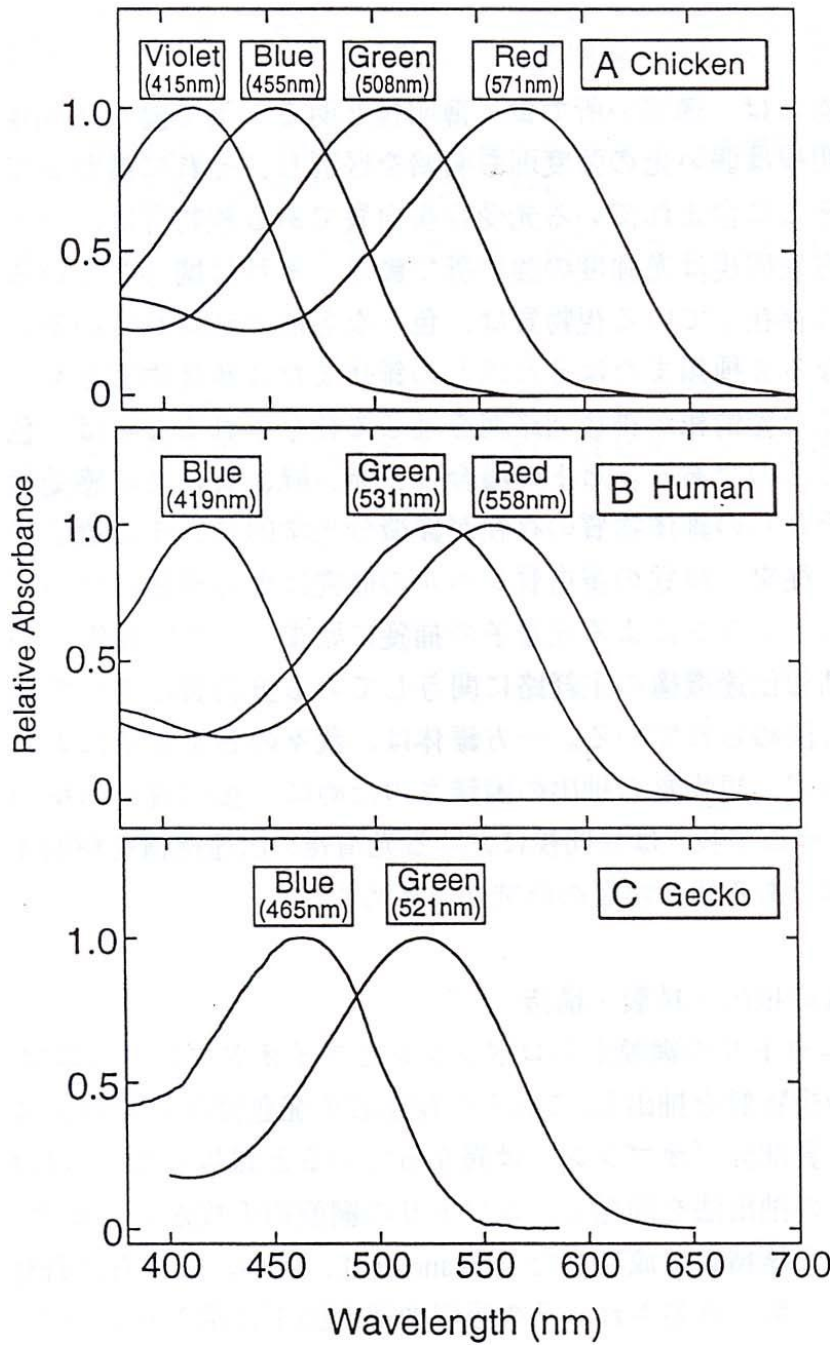


C Color only









ニワトリ

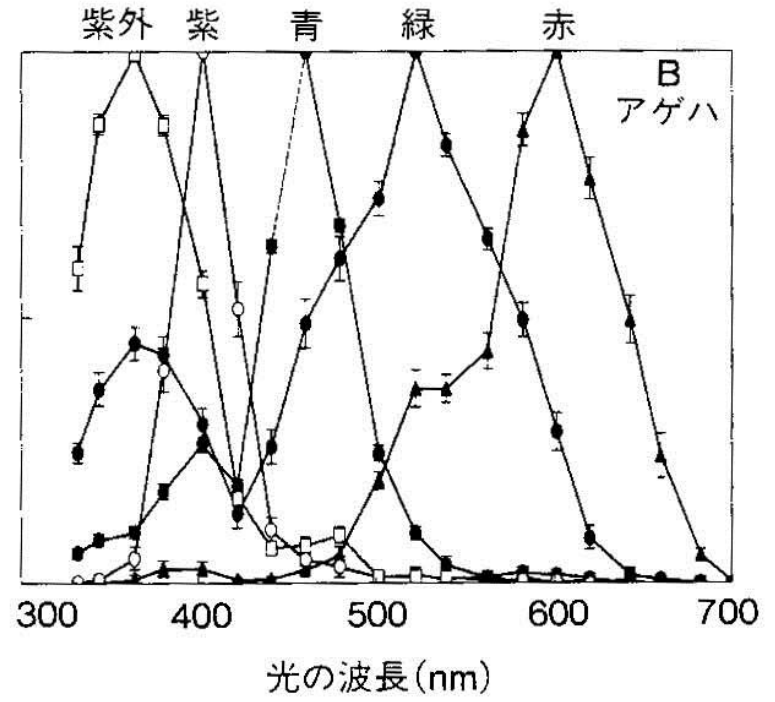
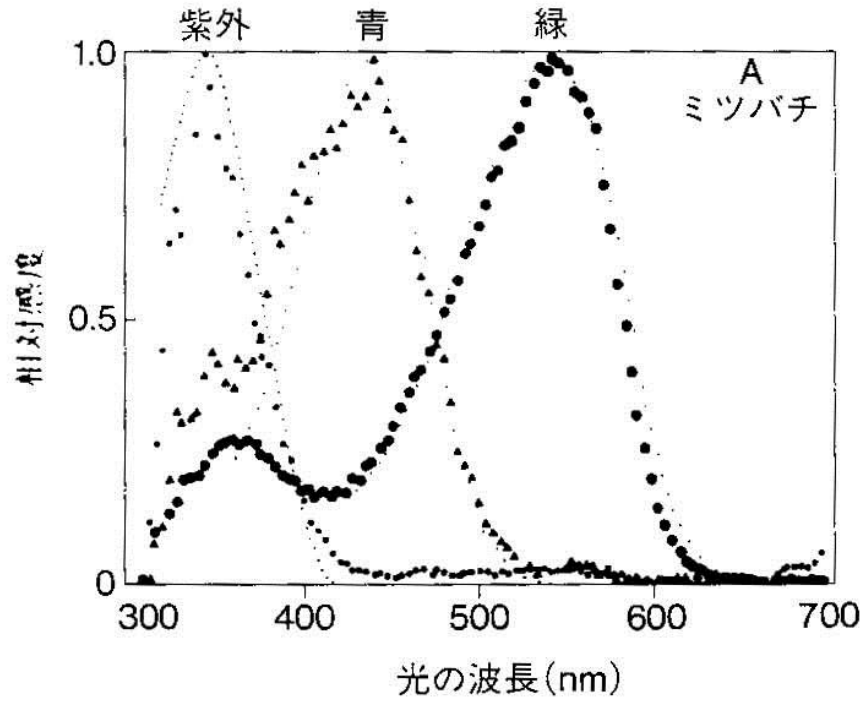
ヒト

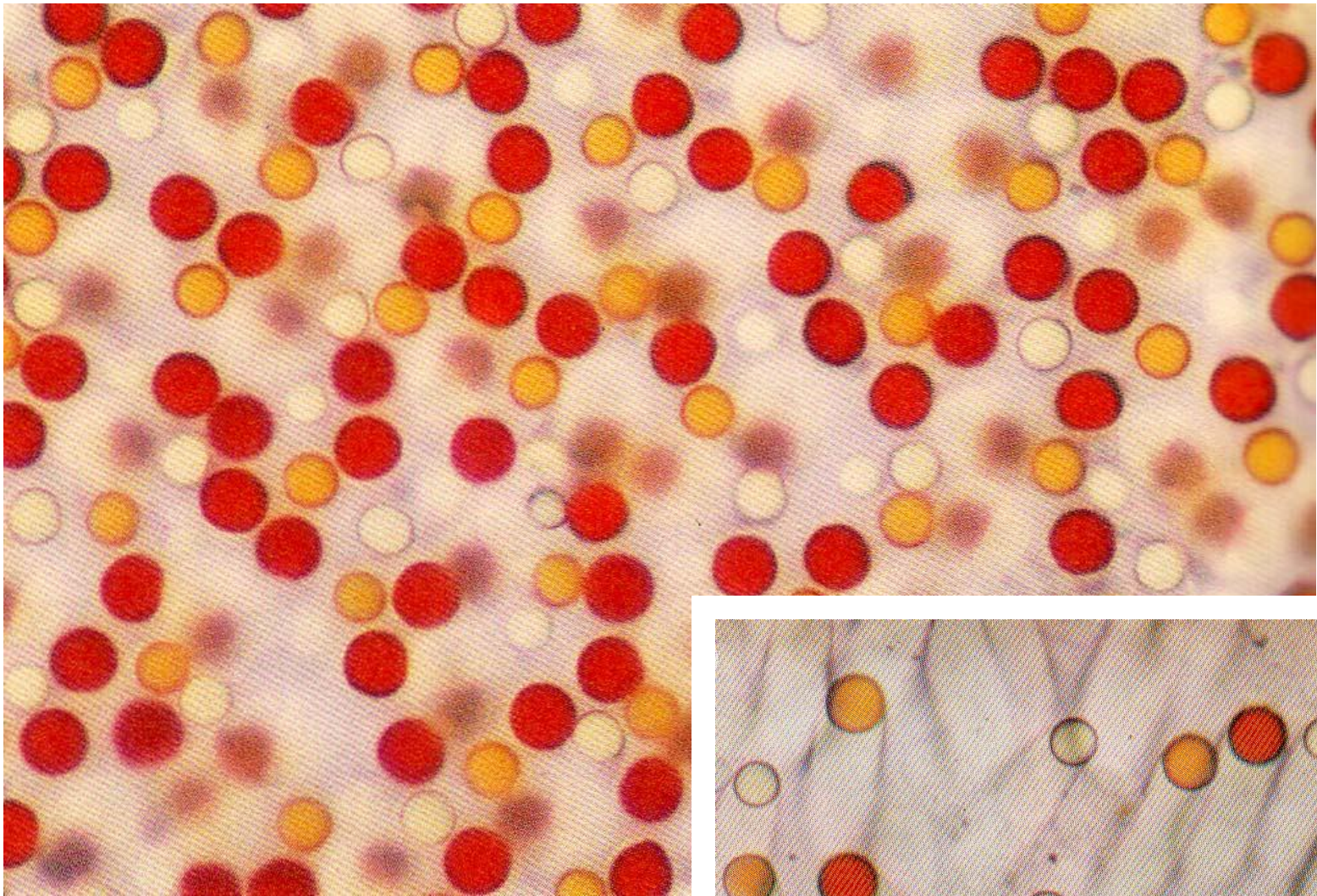
ヤモリ



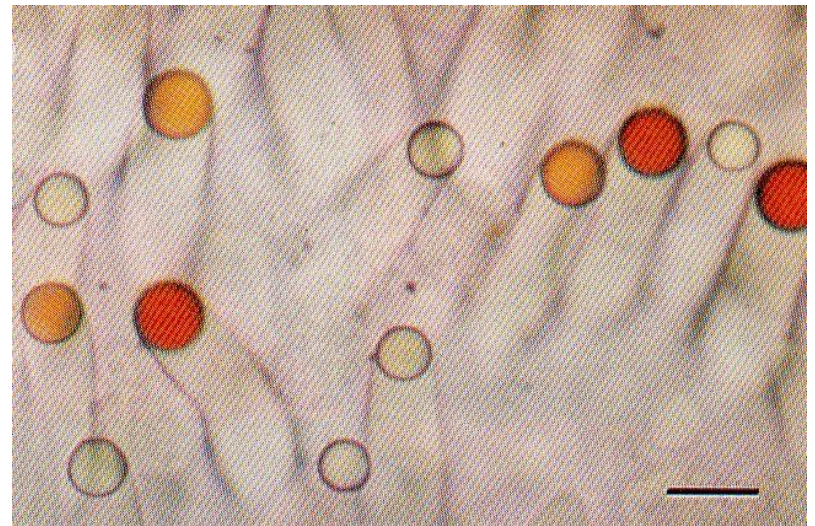
## ミツバチ

## アゲハ

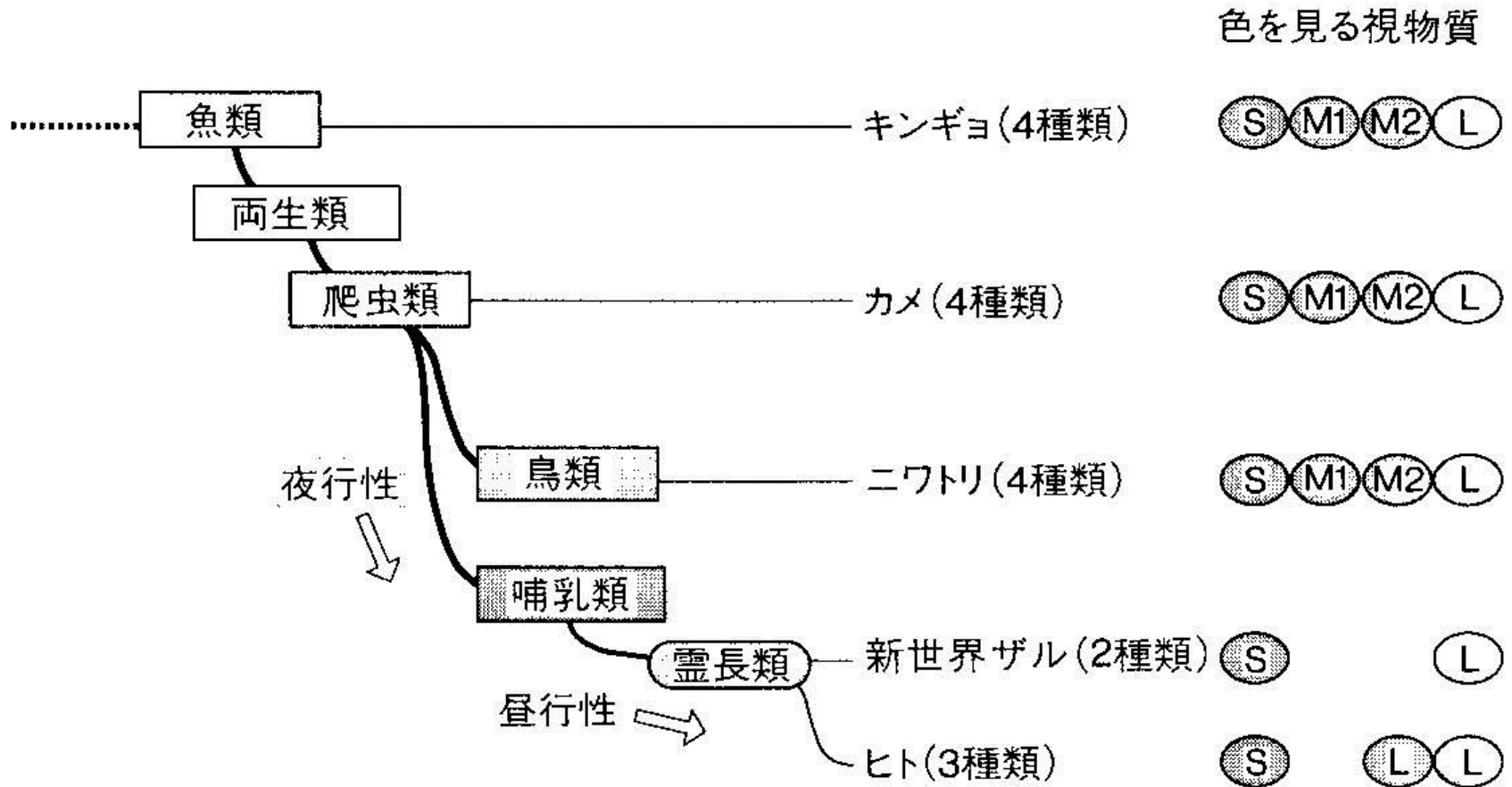




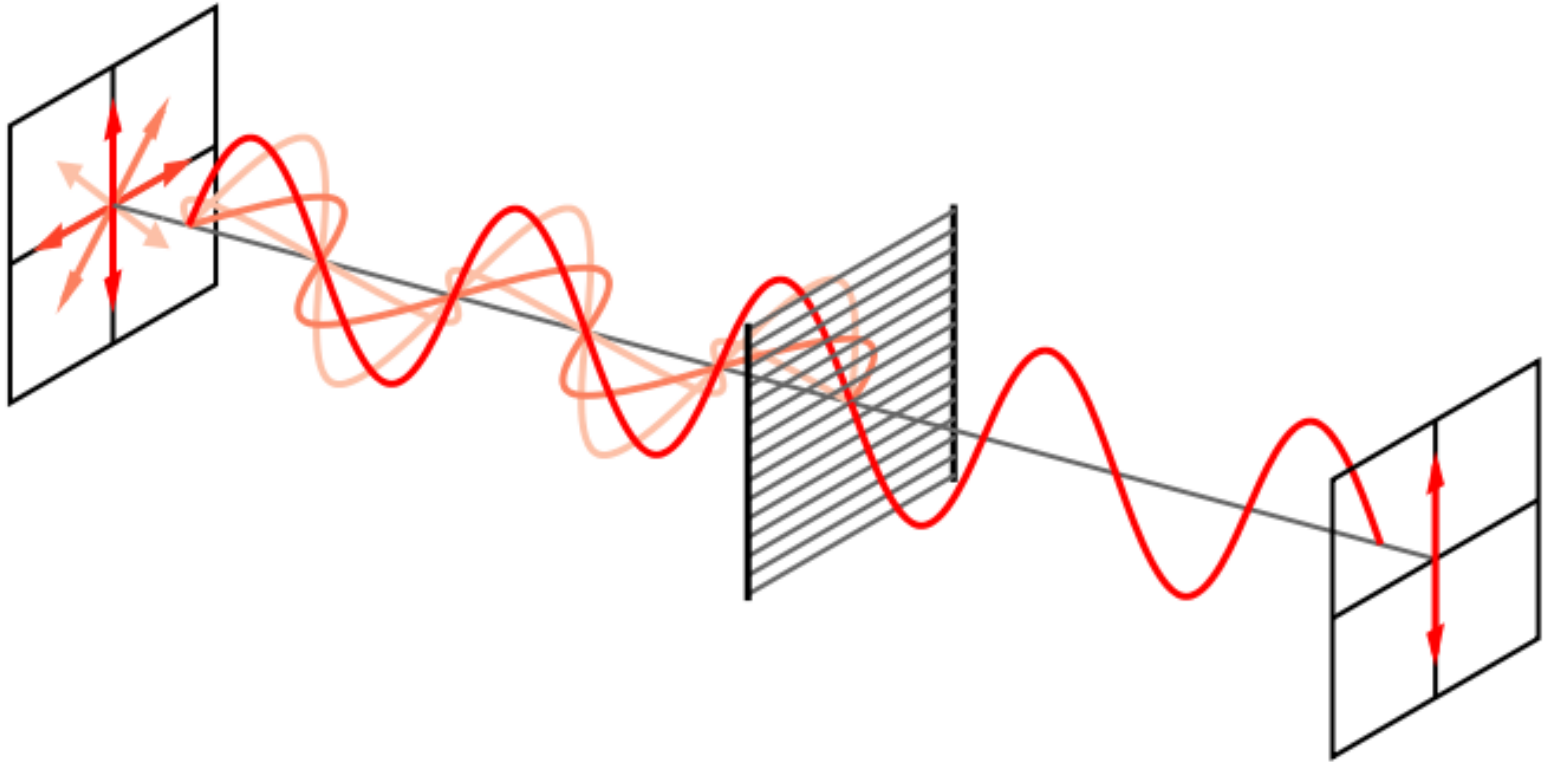
カメ網膜の油滴



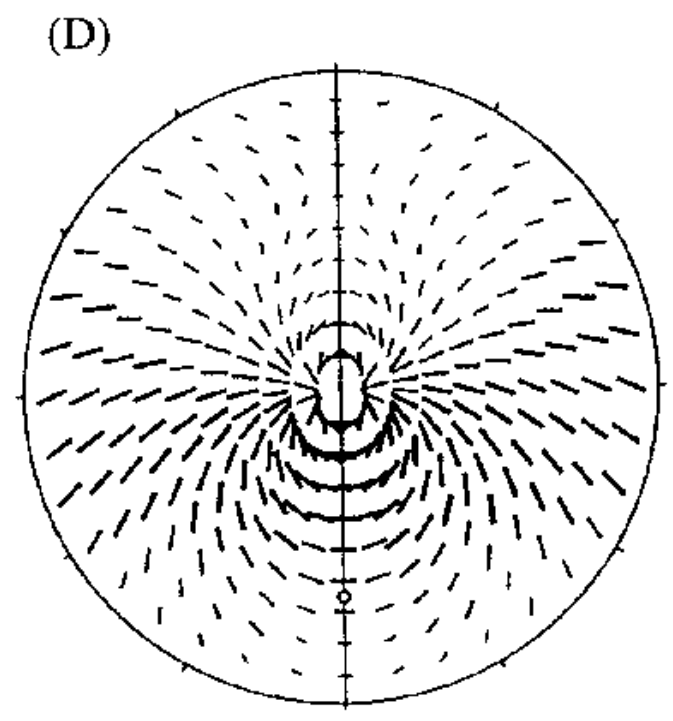
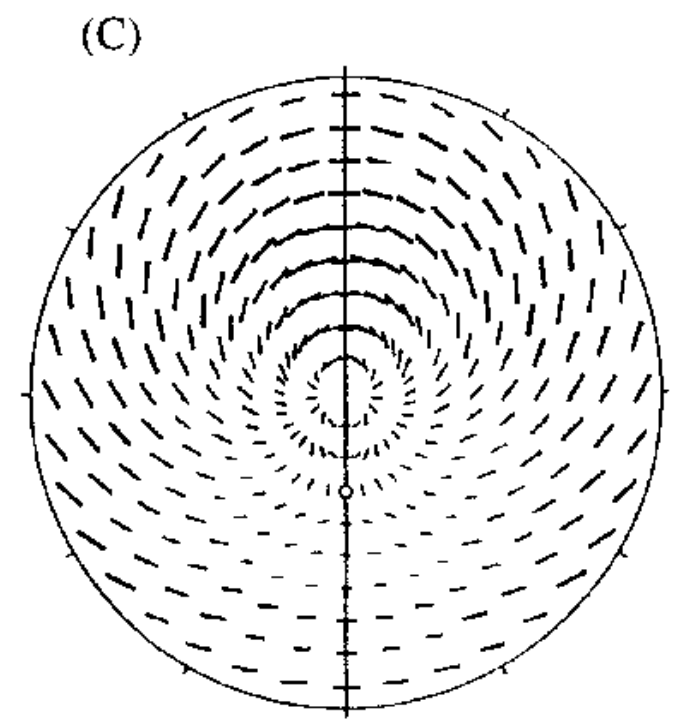
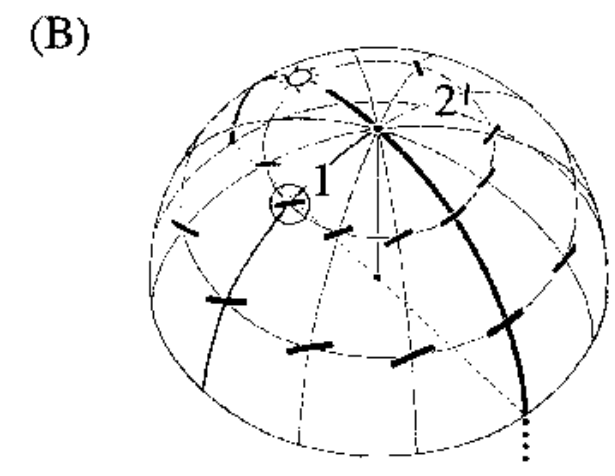
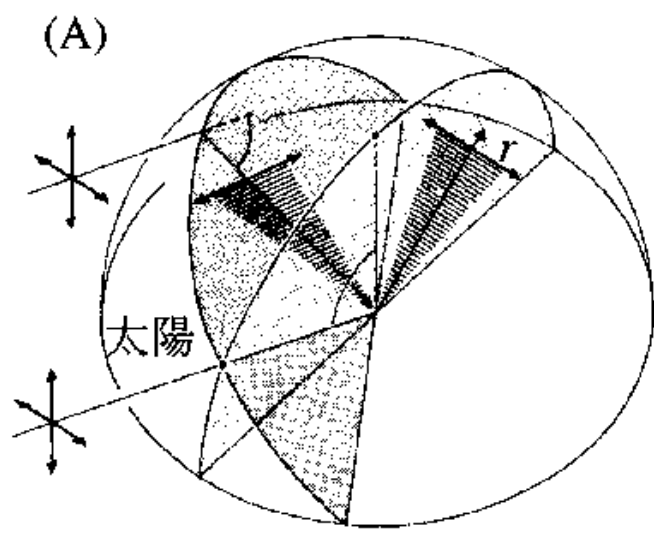
# 動物の進化と色を見る視物質の変遷



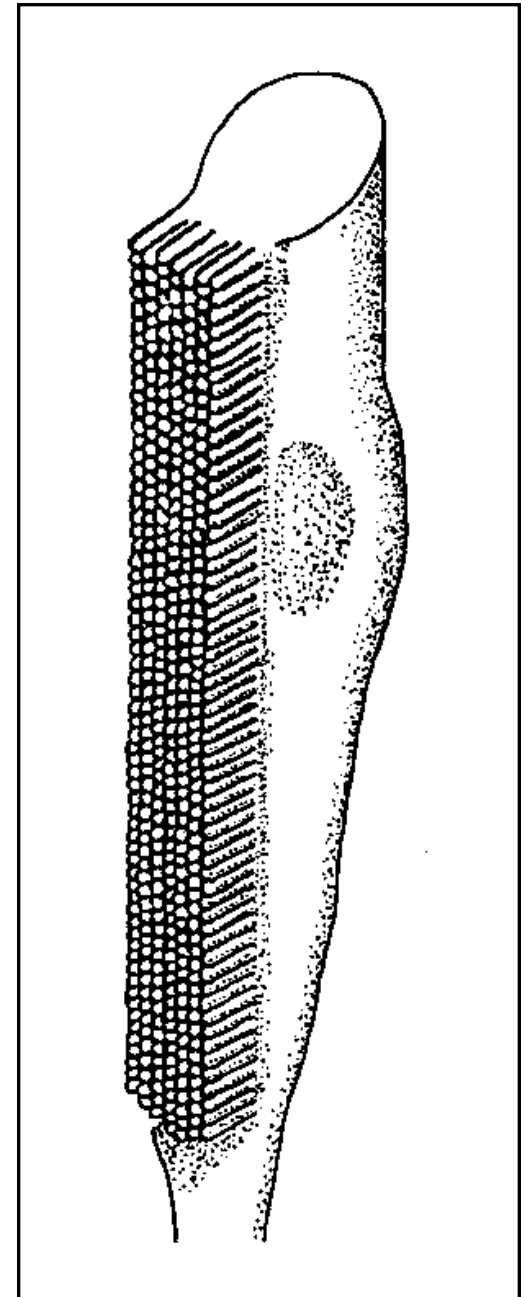
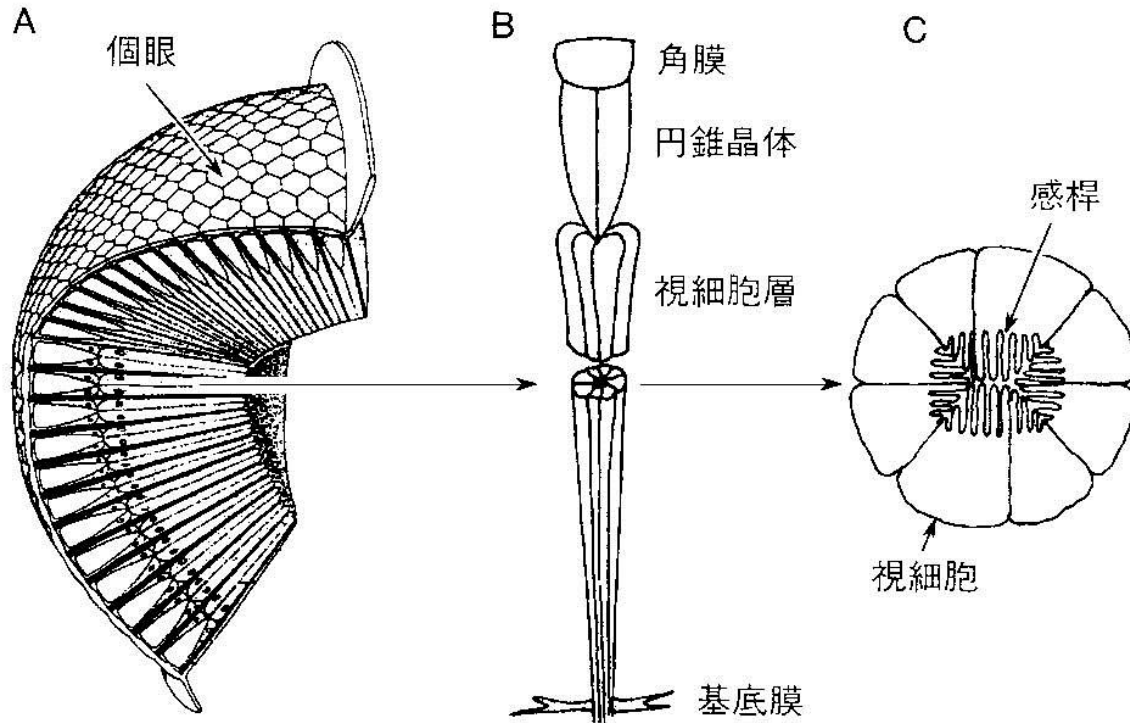
# 偏光



Wikipedia より



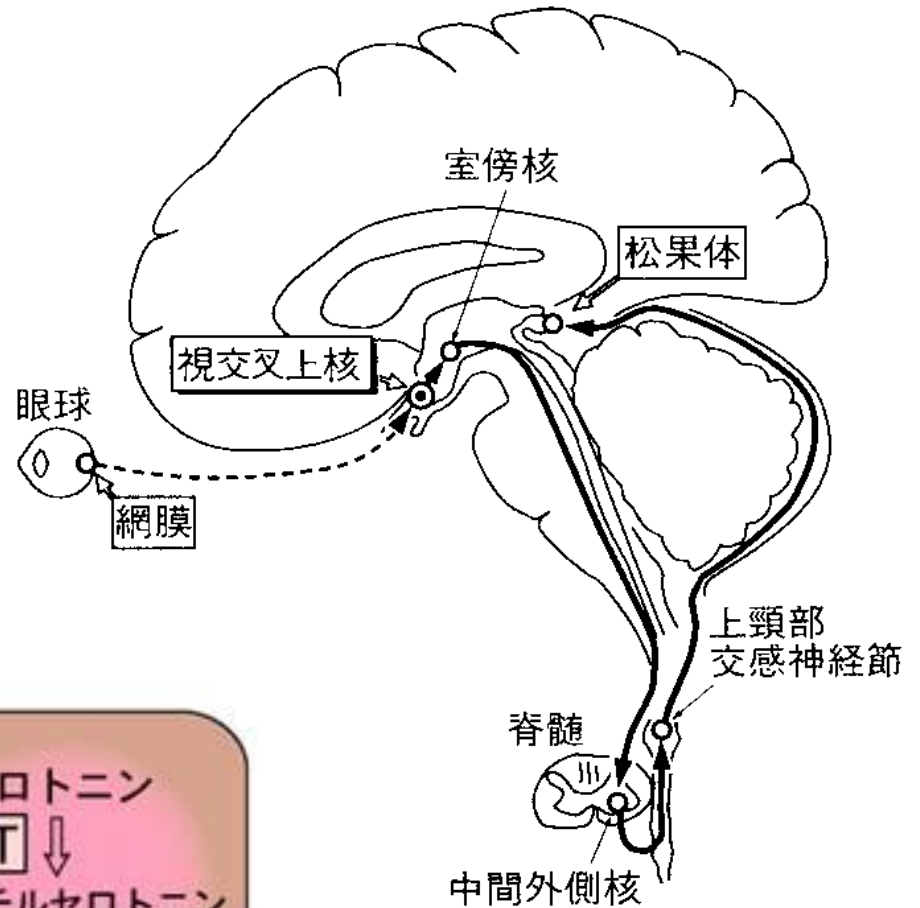
# 複眼の模式図



## 第3の眼

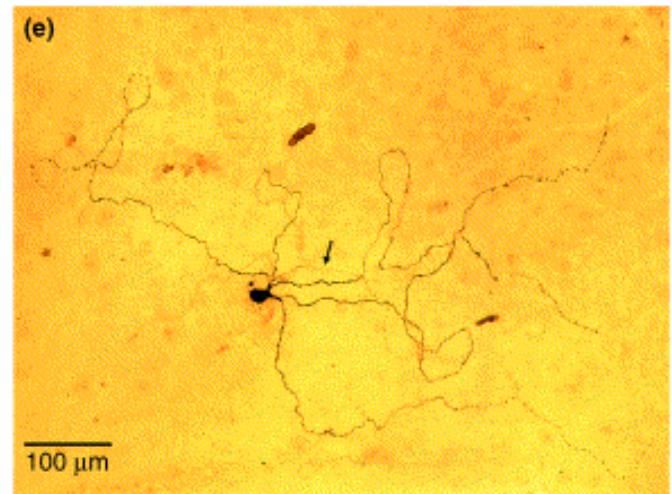
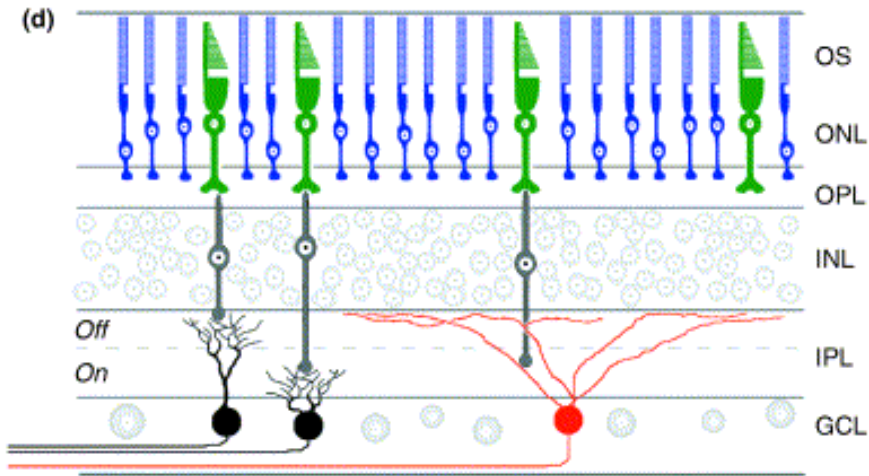
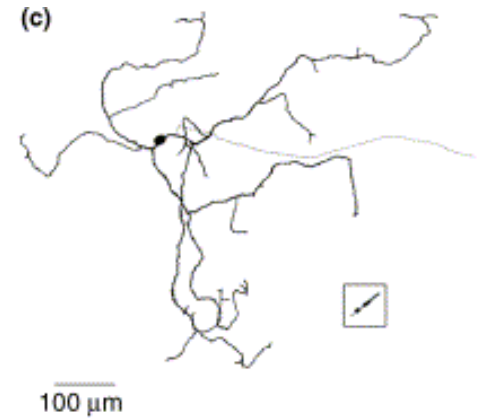
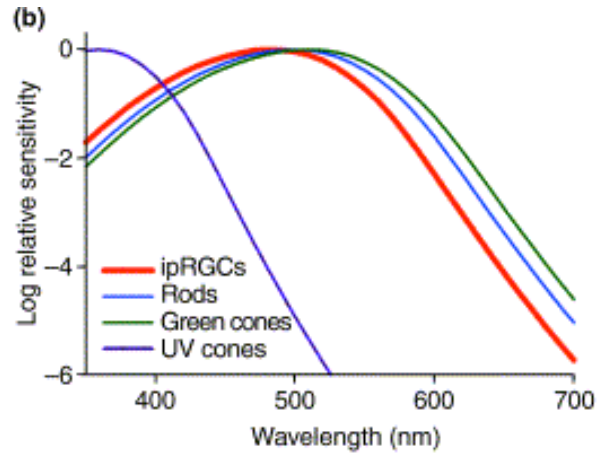
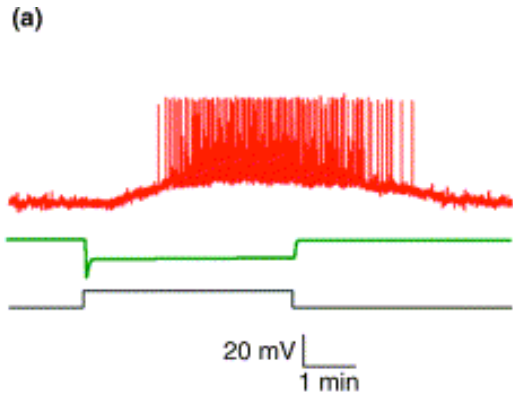


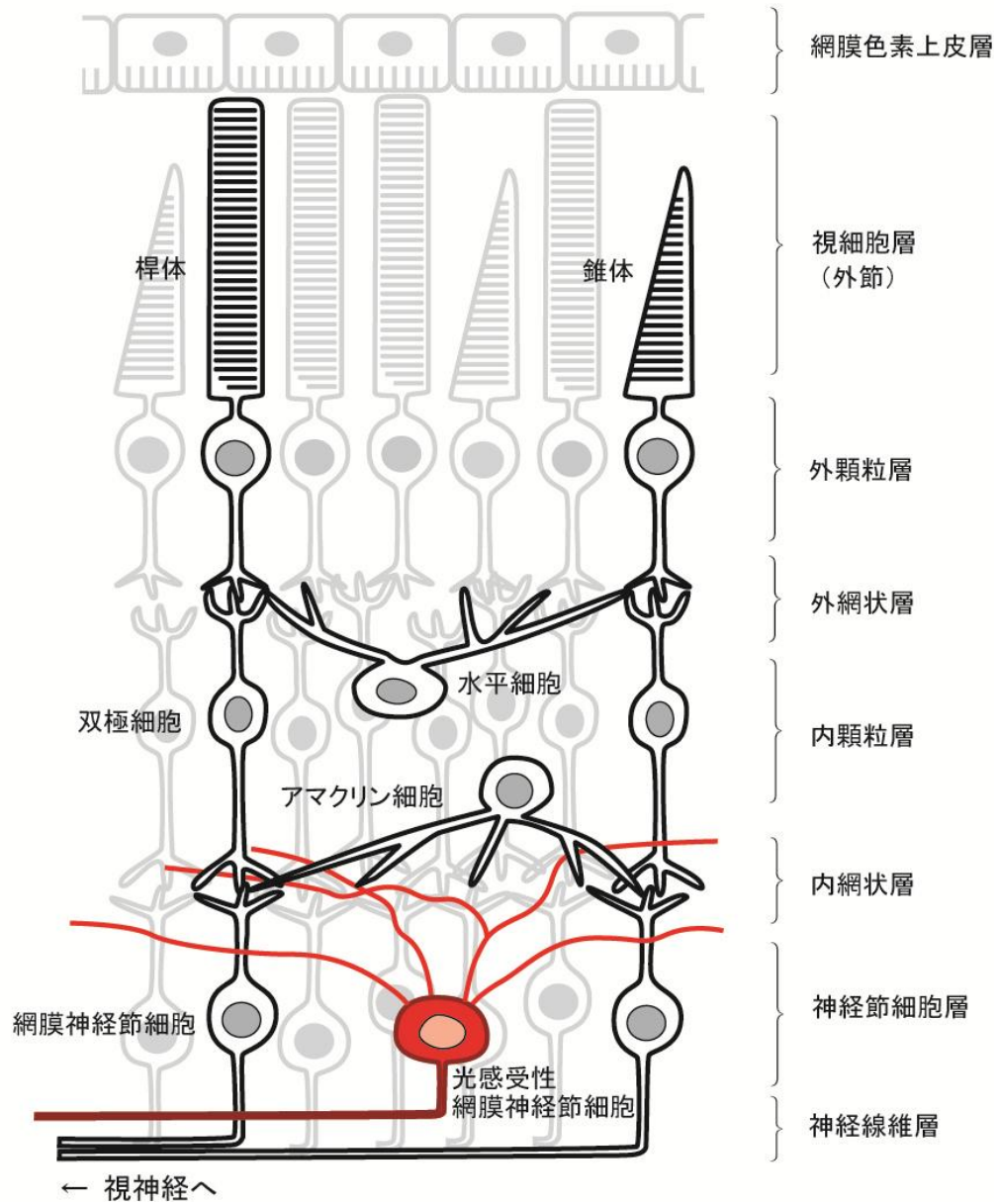
# 松果体における光受容

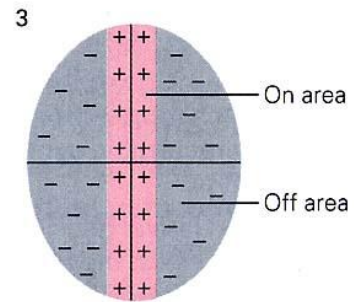
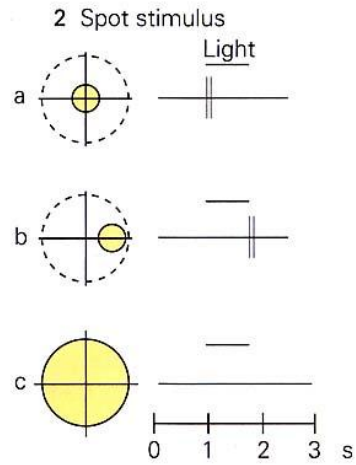
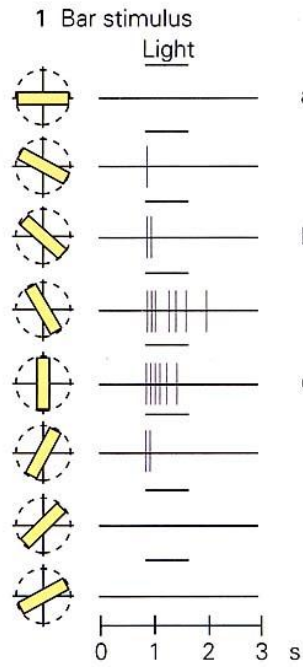
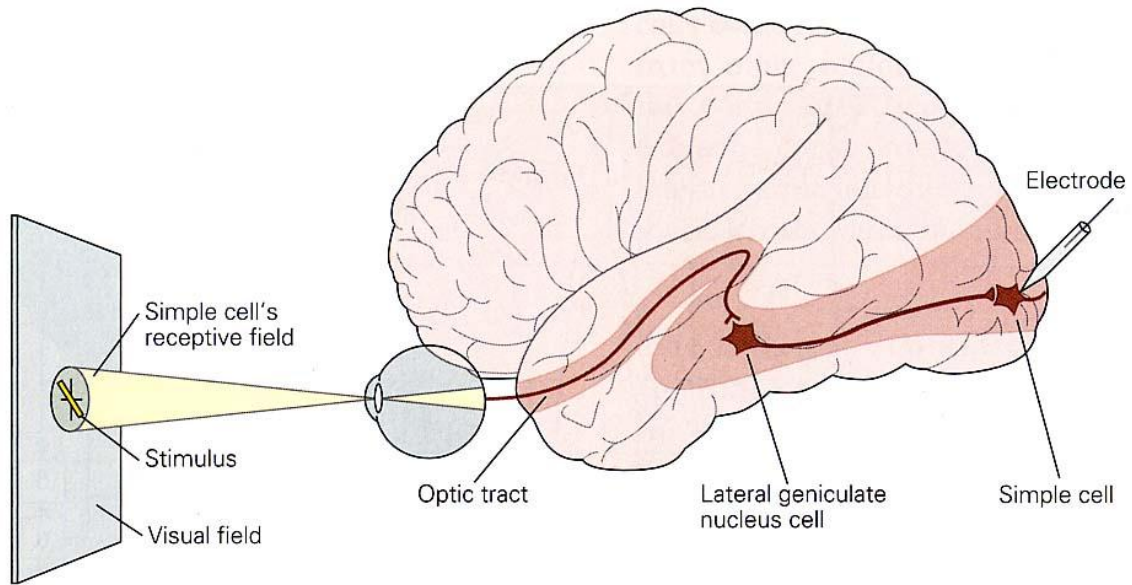


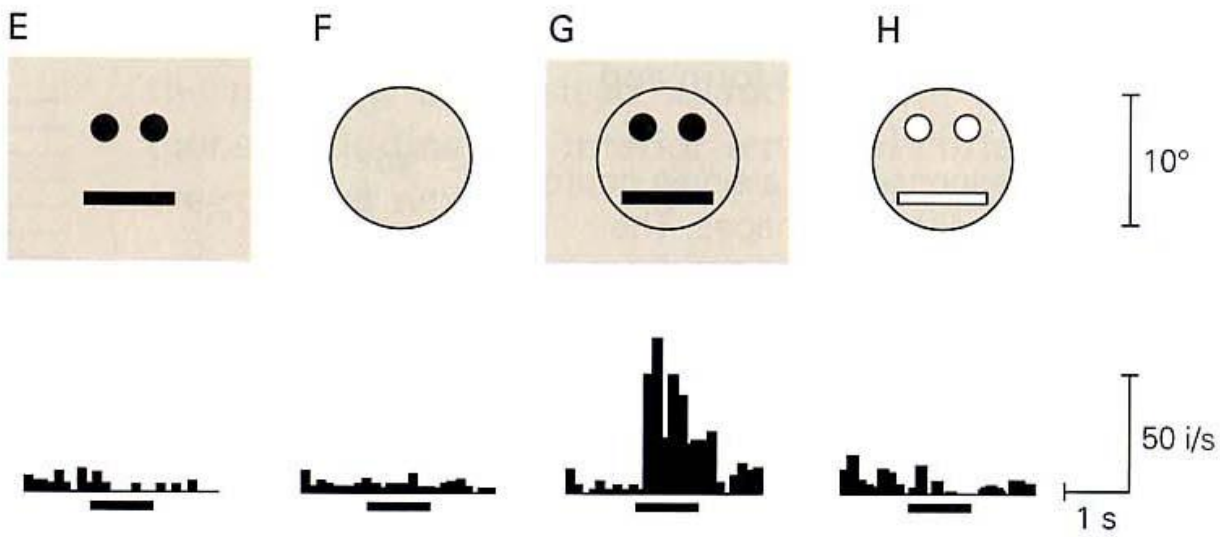
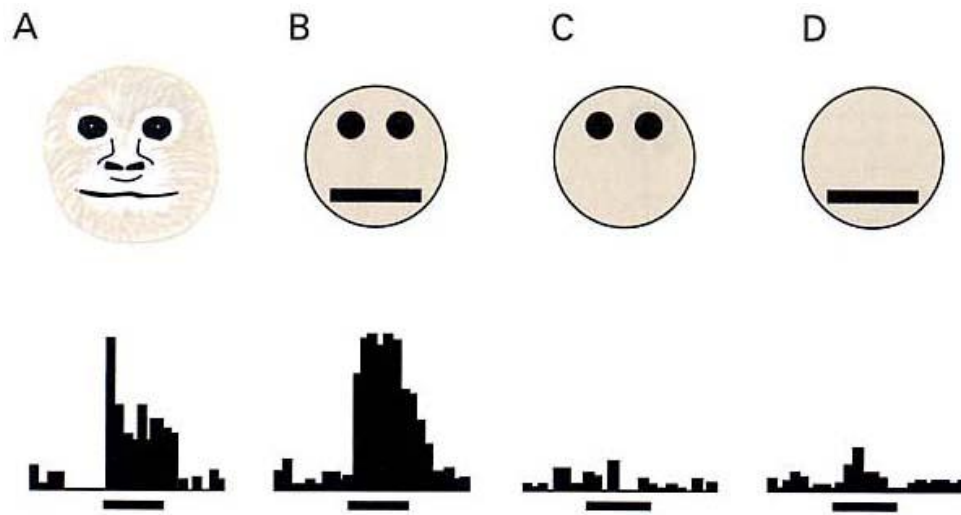


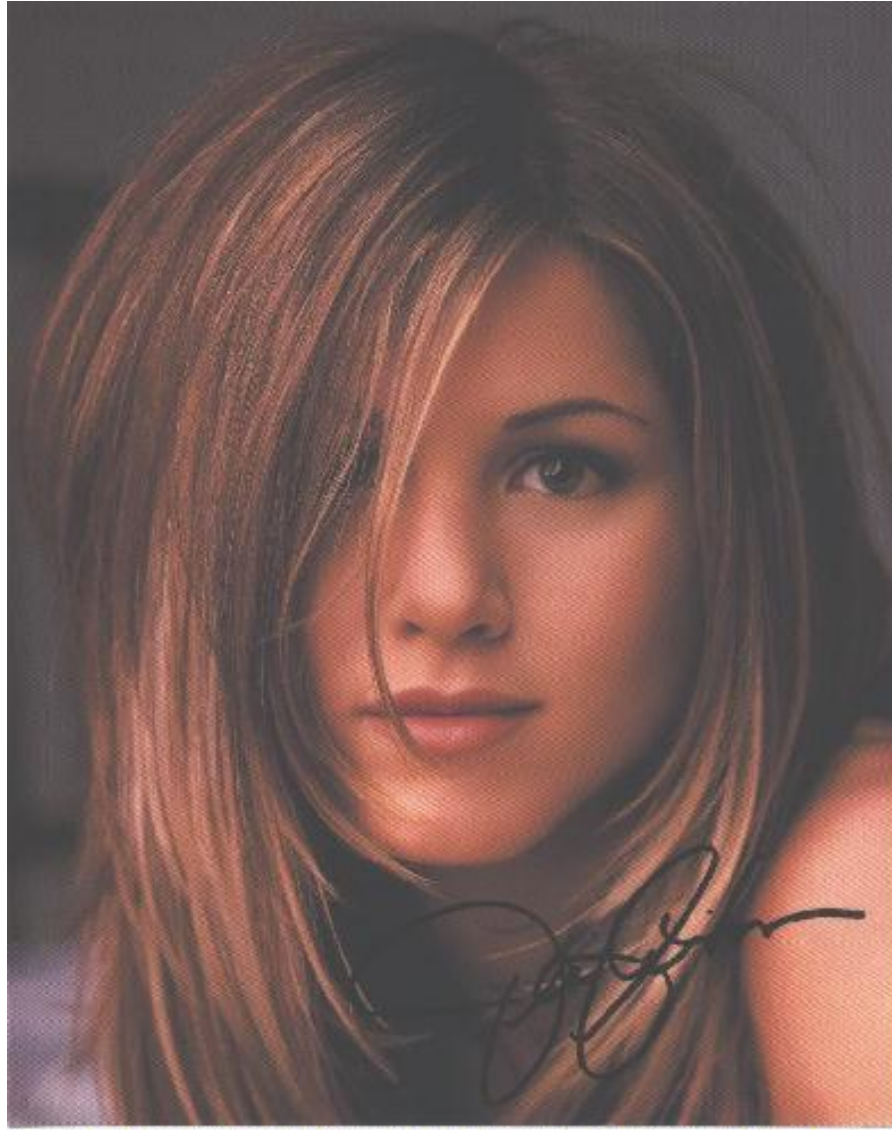
# 光感受性網膜神經節細胞



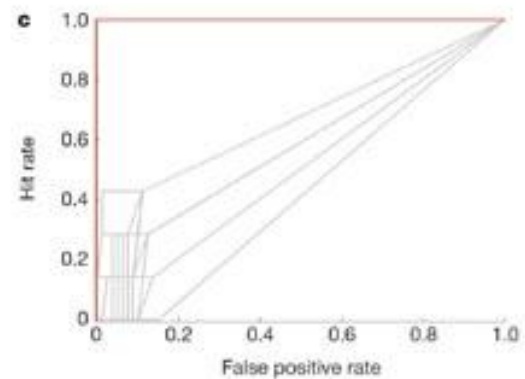
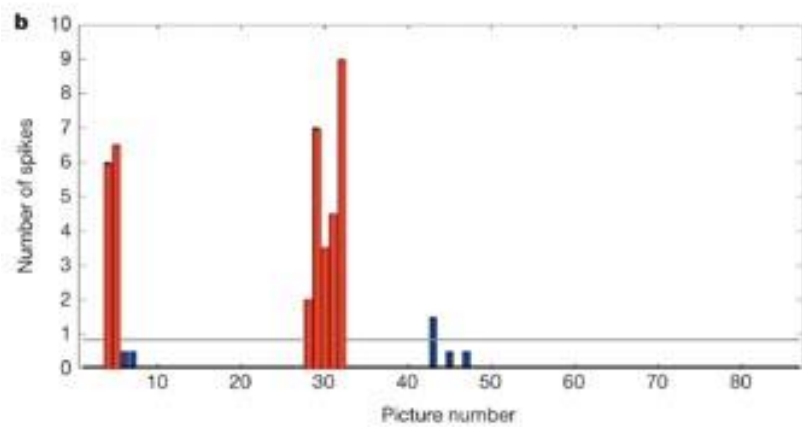






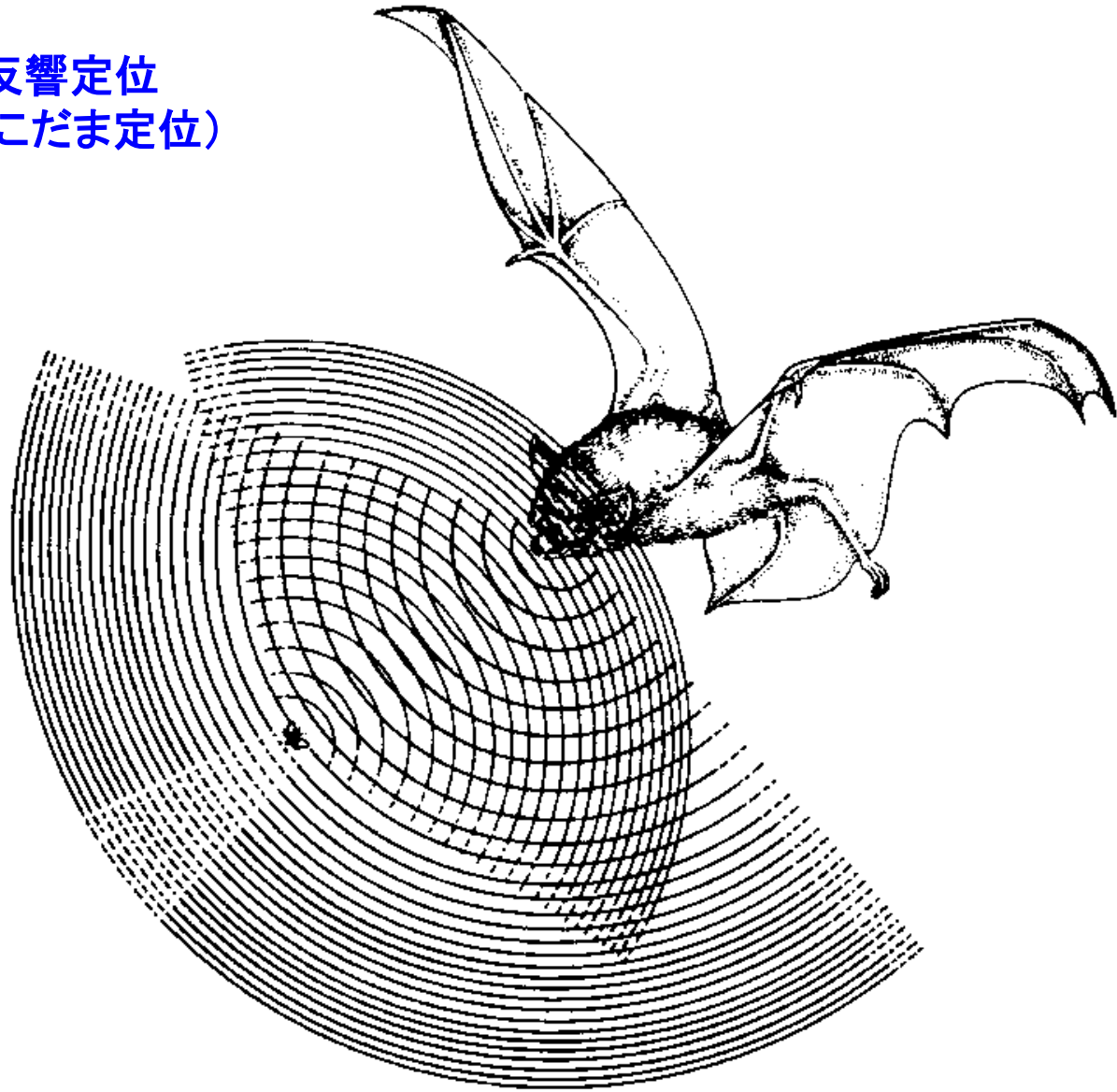


Jennifer Aniston



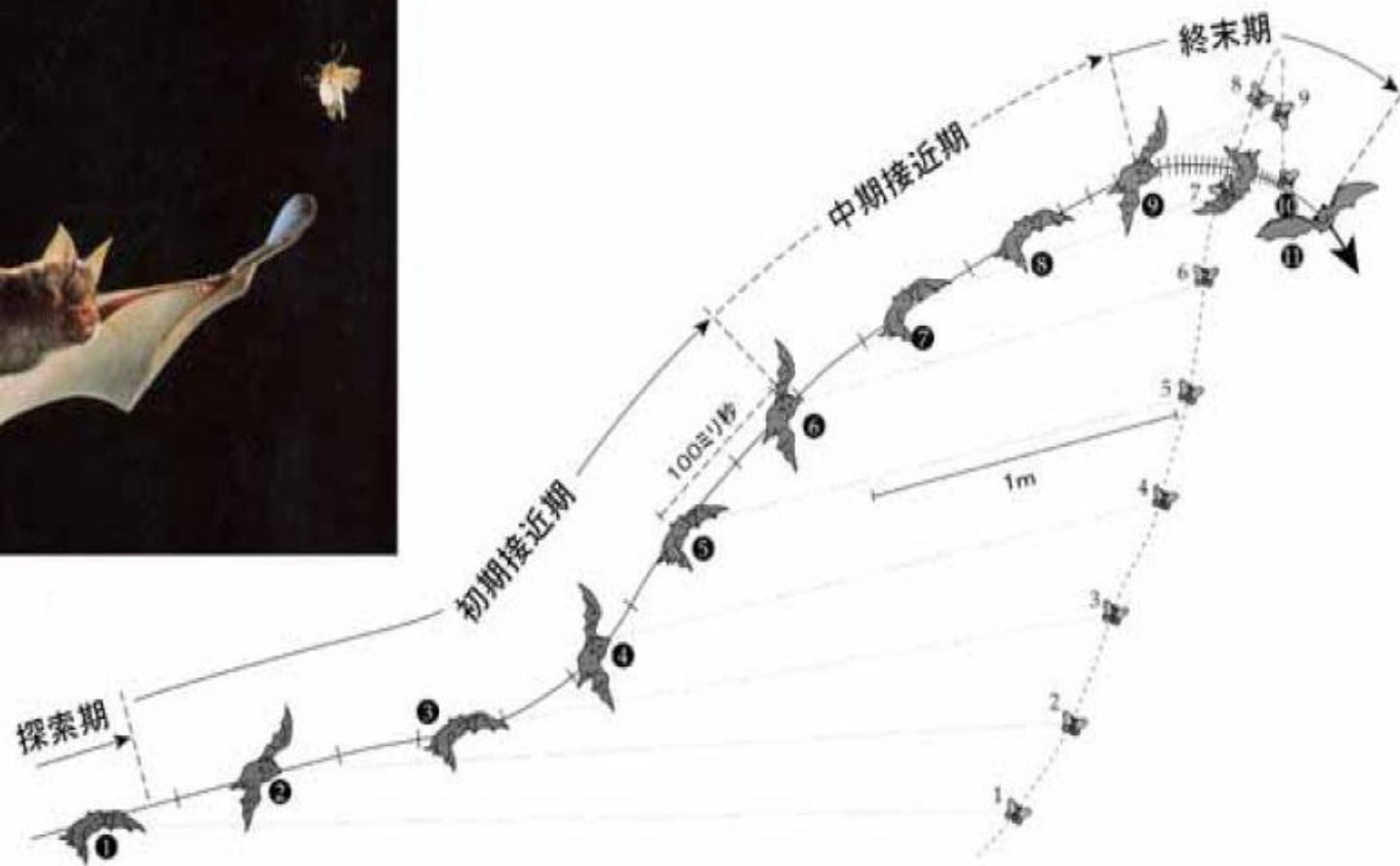
# 動物の特殊な感覚

コウモリの反響定位  
(こだま定位)

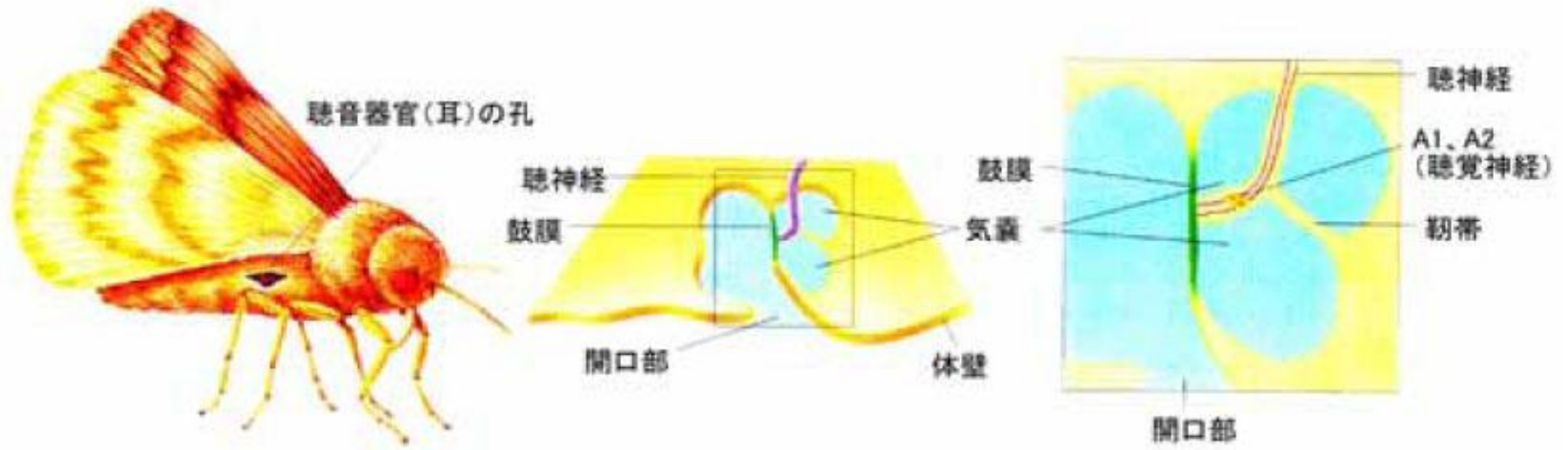


30~110 kHz (超音波)





## ガの防衛戦略



聞こえる範囲: 3 kHz ~ 150 kHz

感度: A1はA2に比べて10倍高い

A1ニューロンはコウモリが30~40 mの距離に近づくと超音波に応答し始める  
A2ニューロンはコウモリが4.5~6 m以内に接近して初めて反応する

## ガの逃避行動

急降下



ガがコウモリから  
4.5~6mの距離にいる時

自然落下



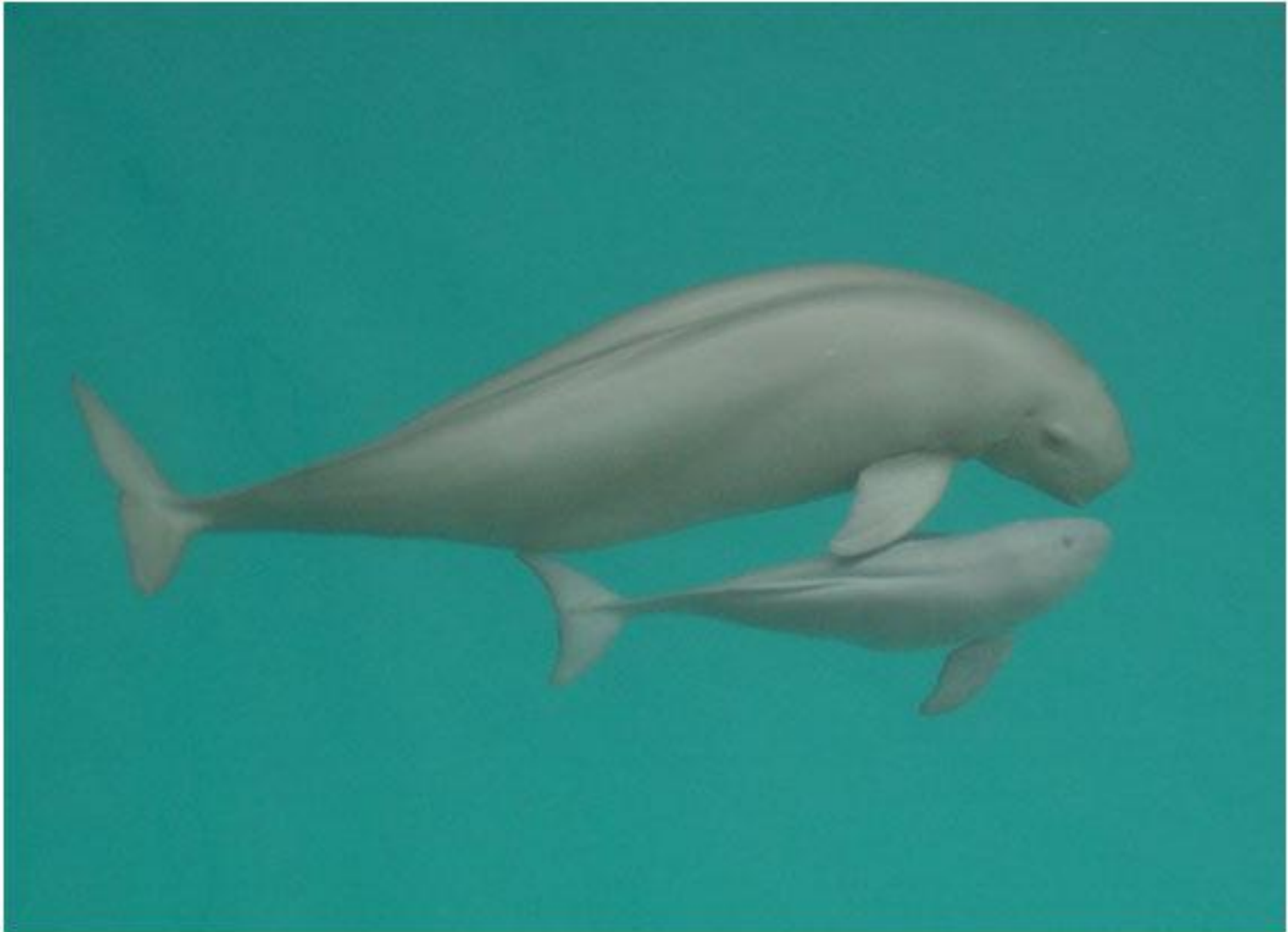
ガがコウモリから  
4.5~6mの距離にいる時

引き返し



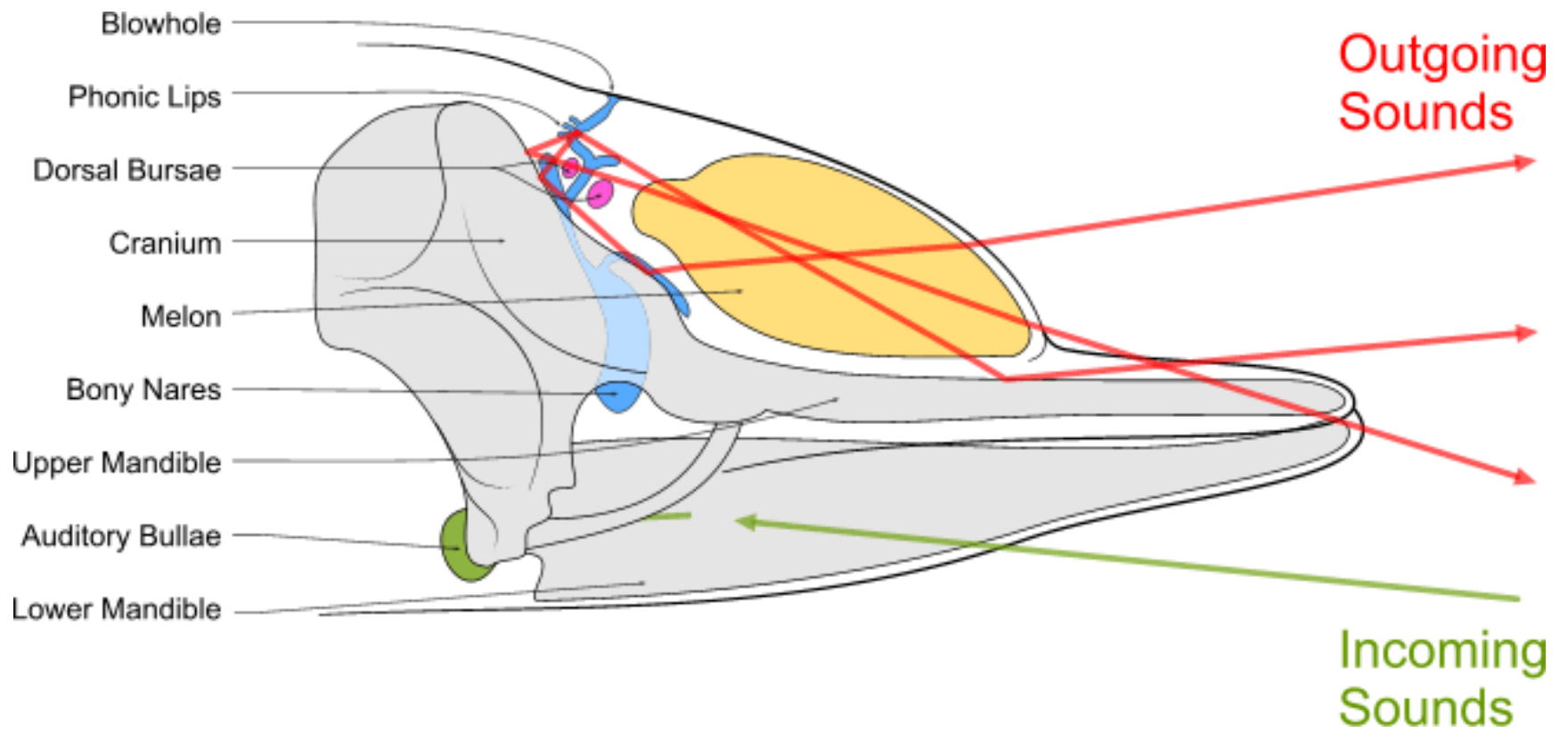
ガがコウモリから  
6~40mの距離にいる時

# イルカのエコロケーション(超音波感覚)

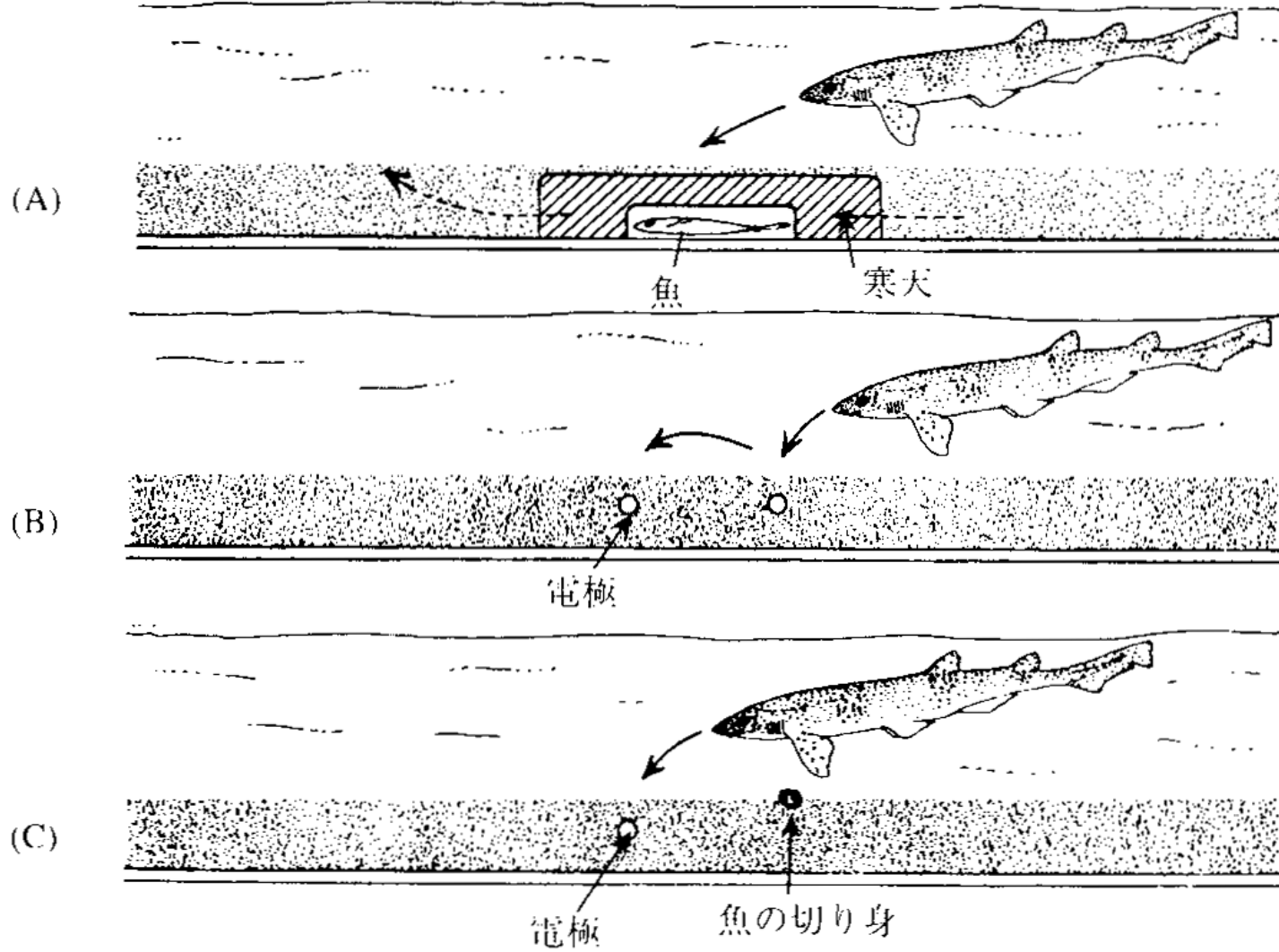


スナメリ (写真提供:水産総合センター 赤松友成)



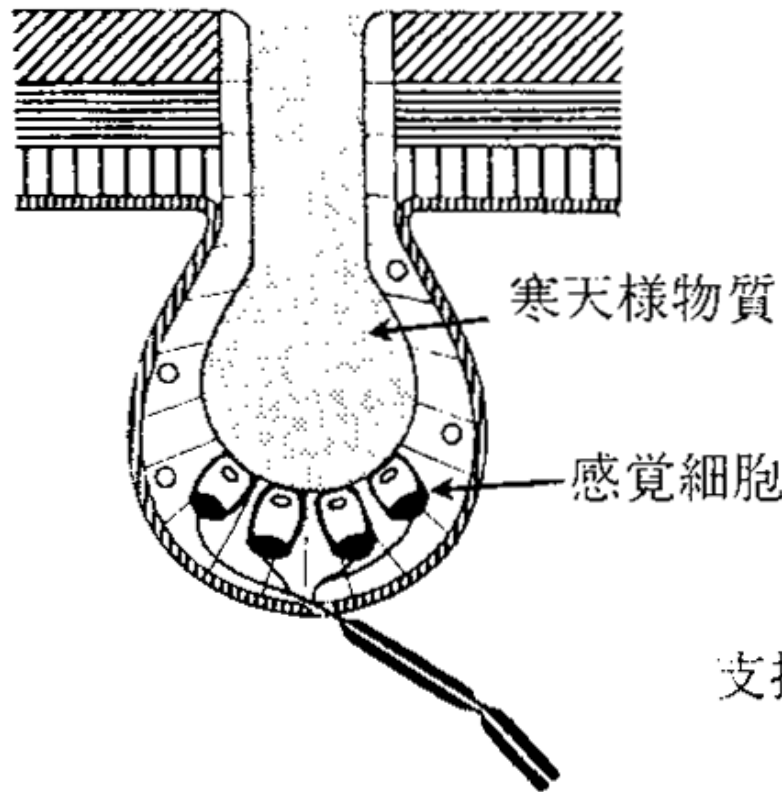


## サメの電気受容による餌の検出

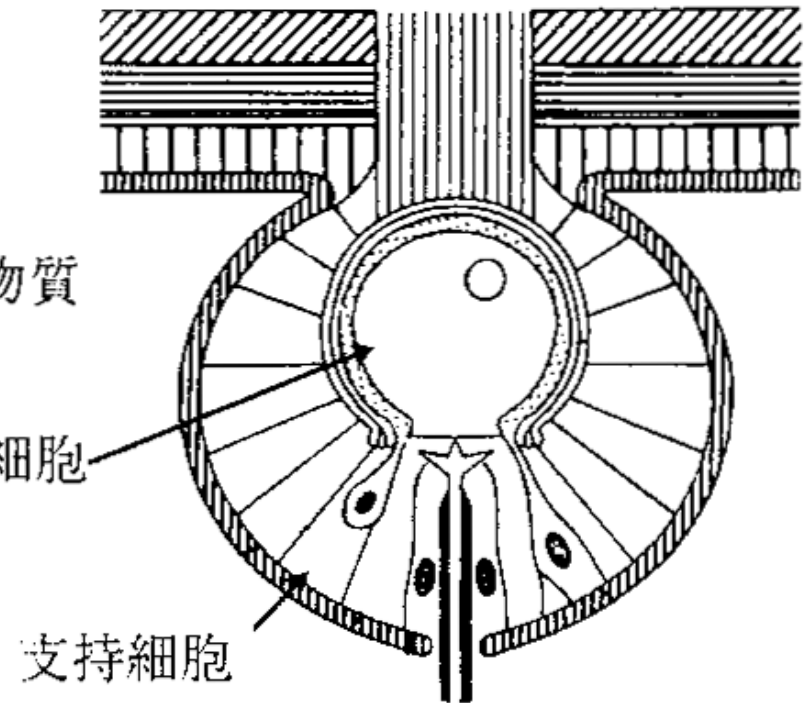


## 2種類の電気受容器官

(A) 瓶型電気受容器



(B) 結節型電気受容器





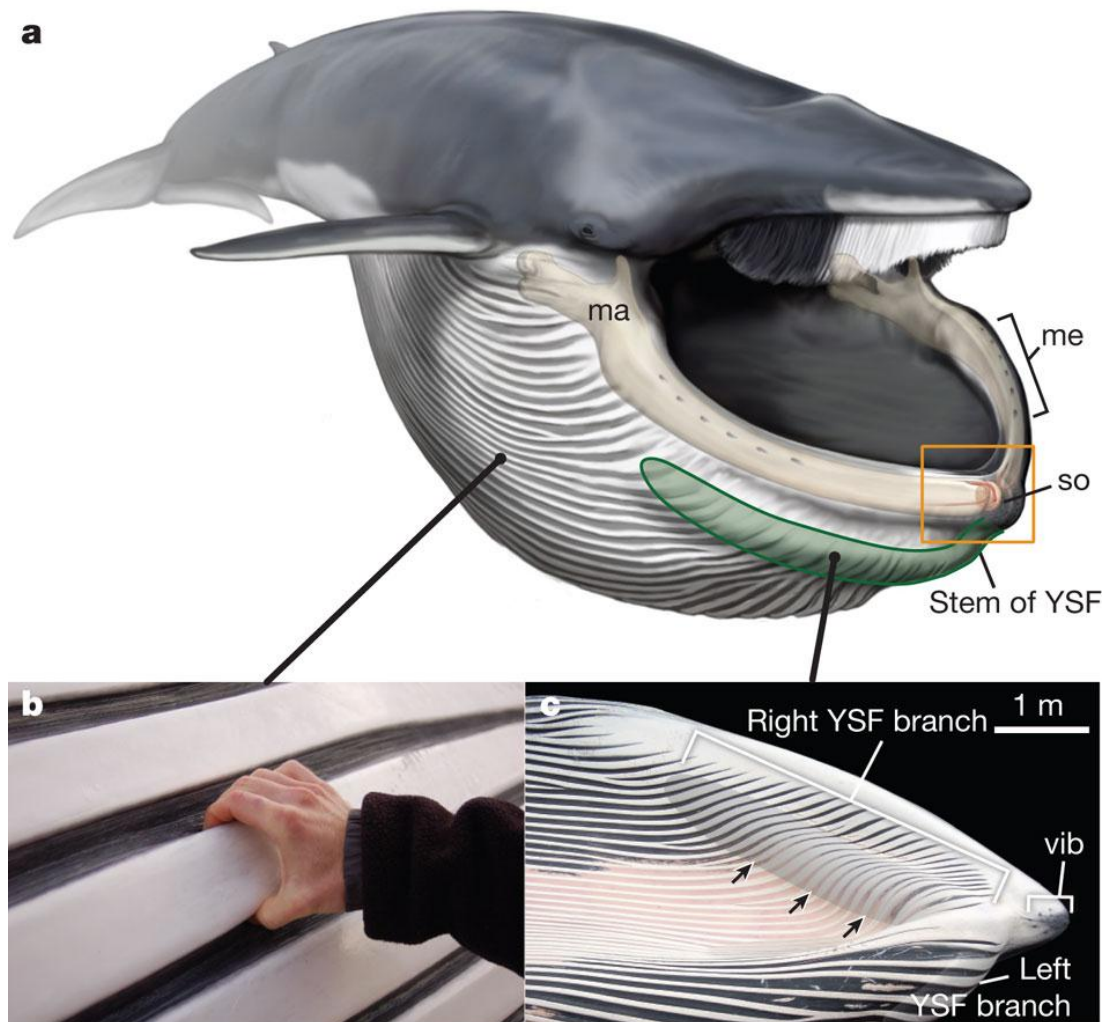
## ヘビの赤外線センサー



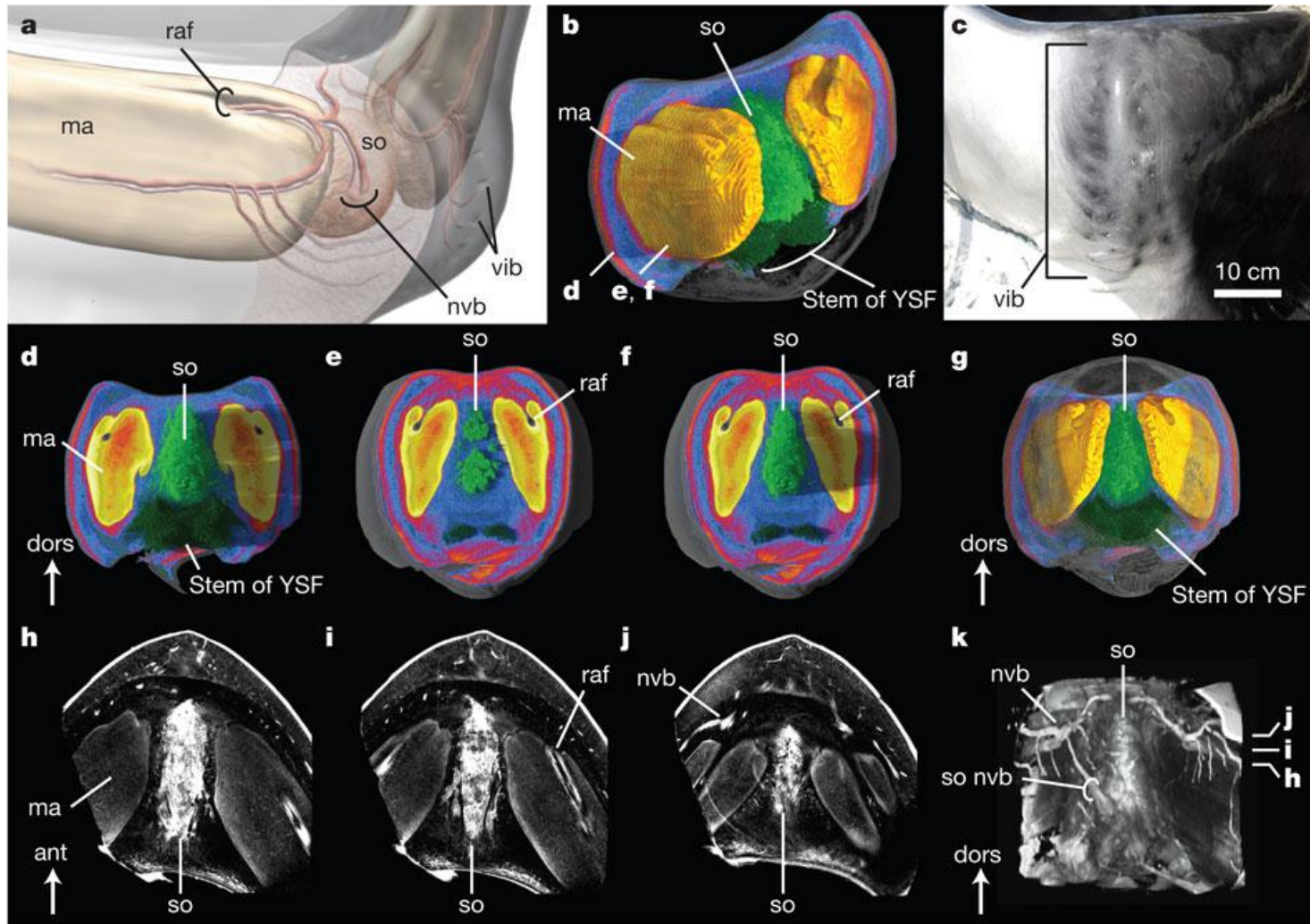
[http://perenty.air-nifty.com/reptiles\\_cage/cat434011/index.html](http://perenty.air-nifty.com/reptiles_cage/cat434011/index.html)

Pit organ (ピット器官)

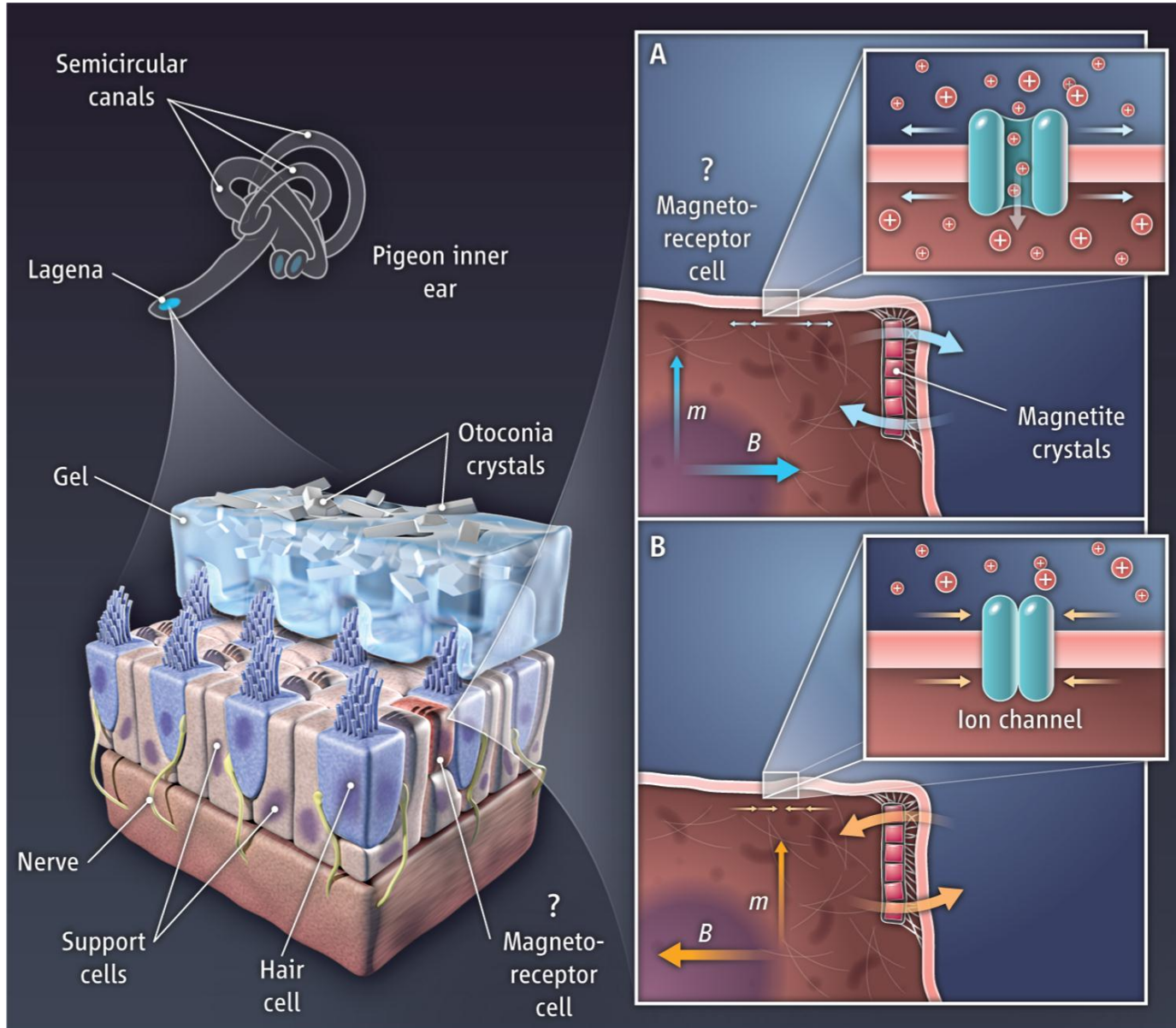
Key jaw anatomy of a rorqual lunge, shown in a fin whale (*B. physalus*).



Digital imaging of the rostral chin, shown in fin whales (*B. physalus*).

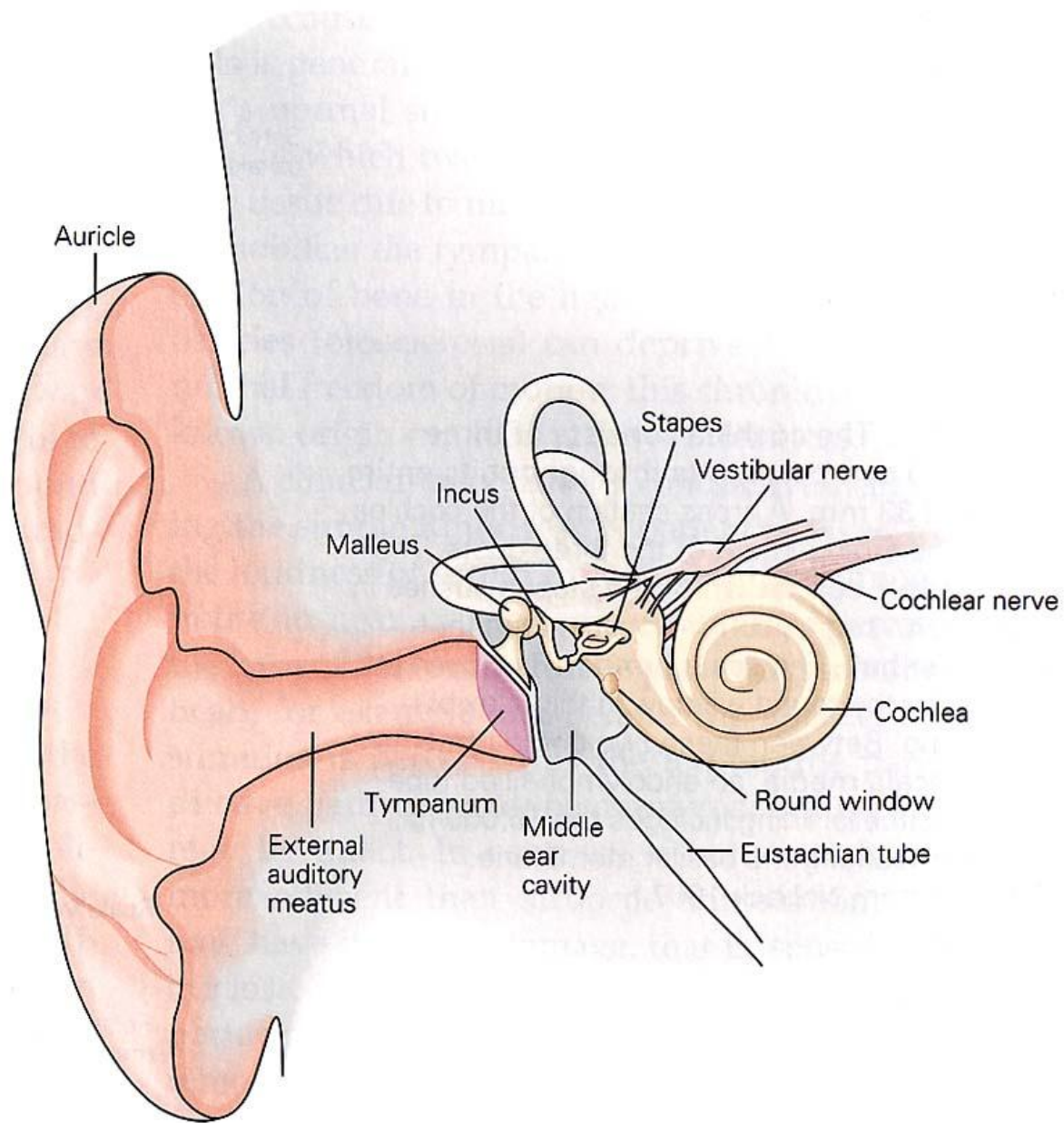


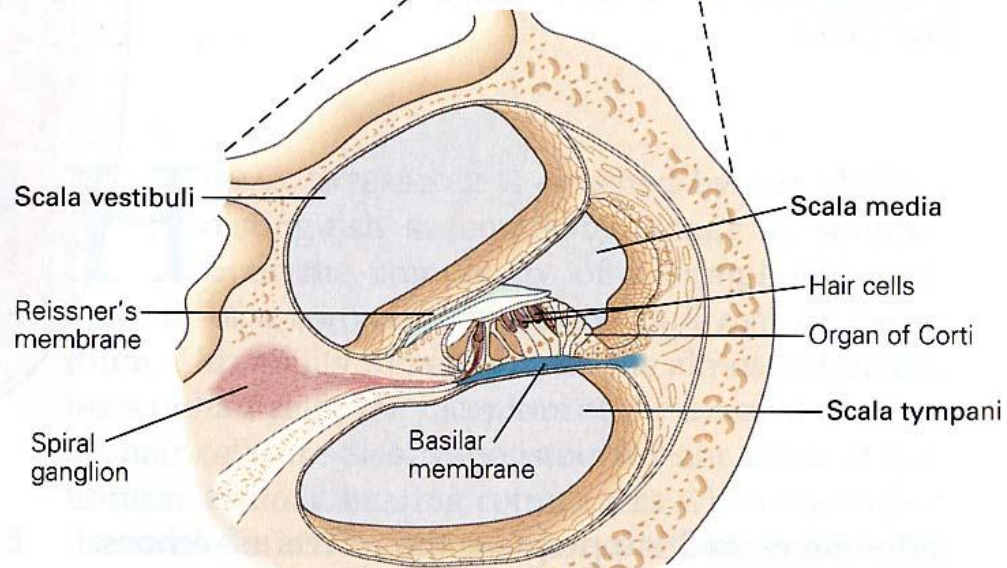
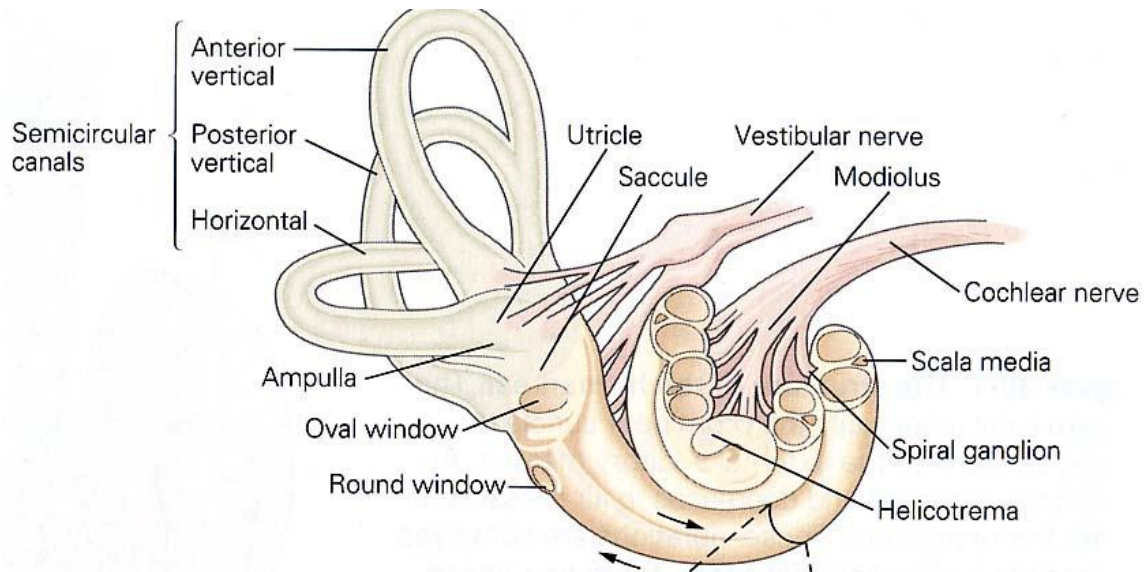
# ハトの磁気感覚



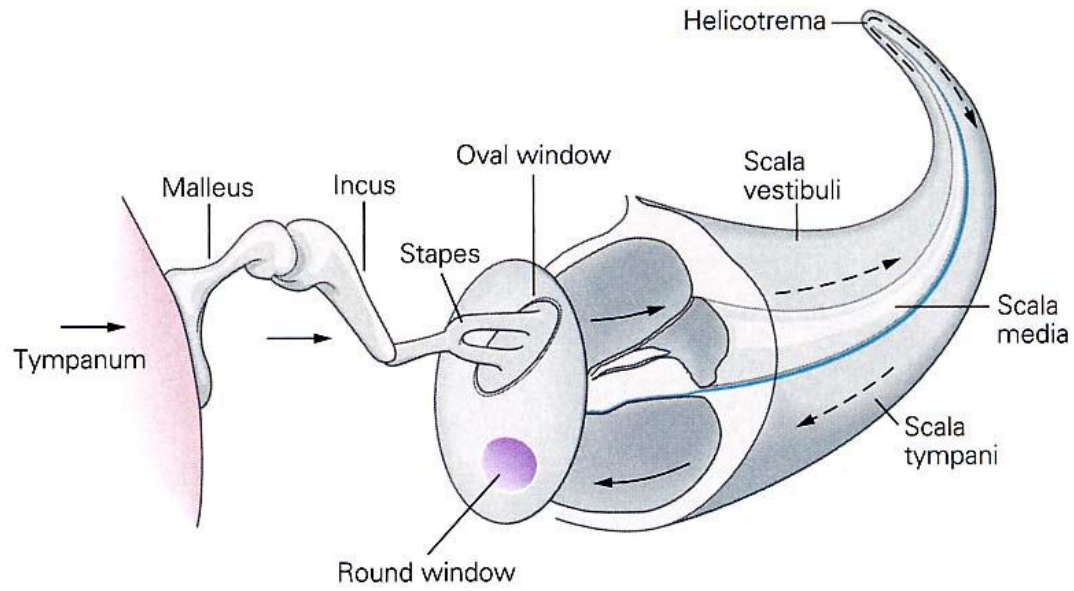
# 聽覺

( Hearing )

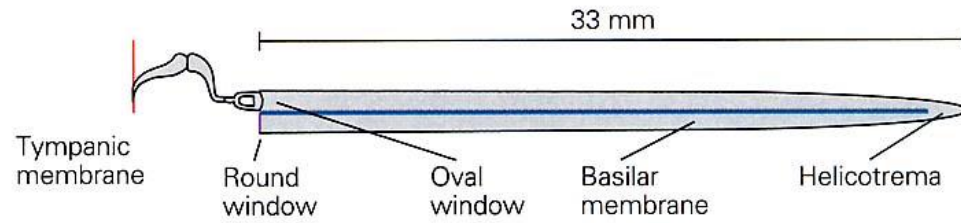




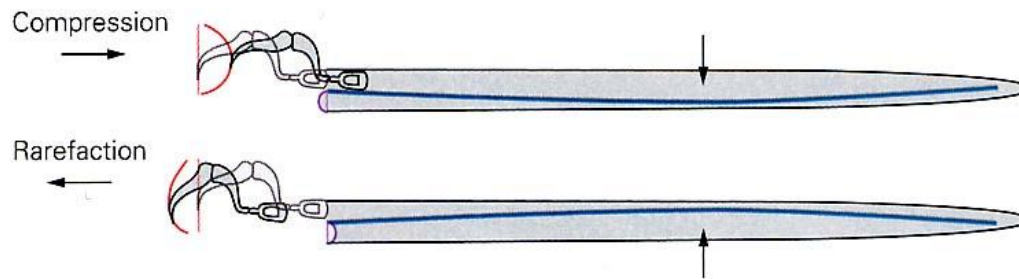
A



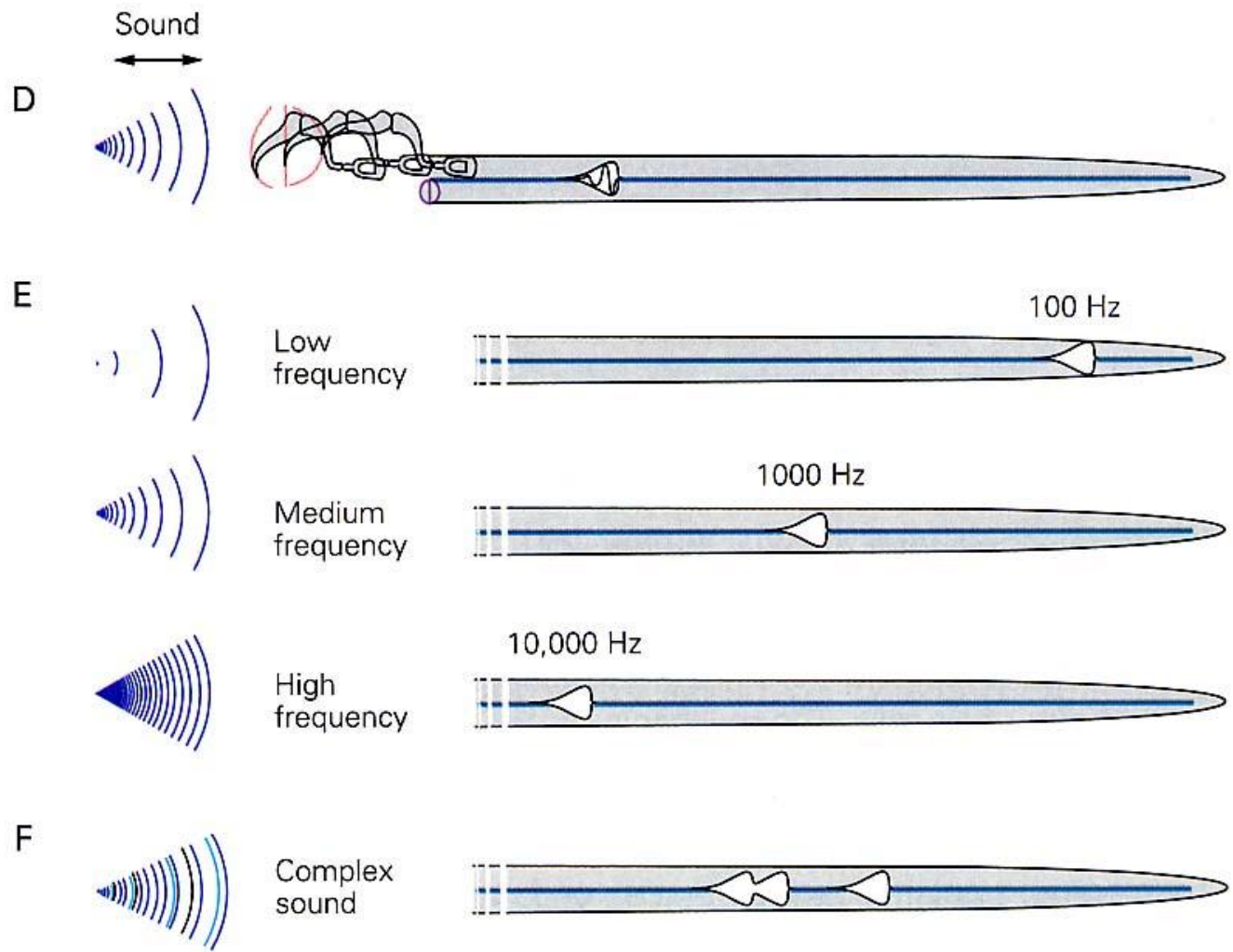
B



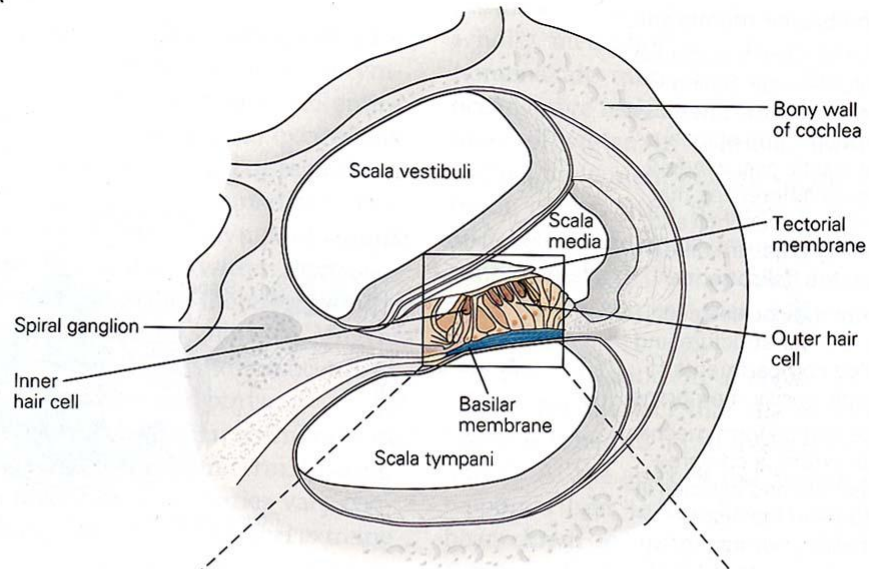
C



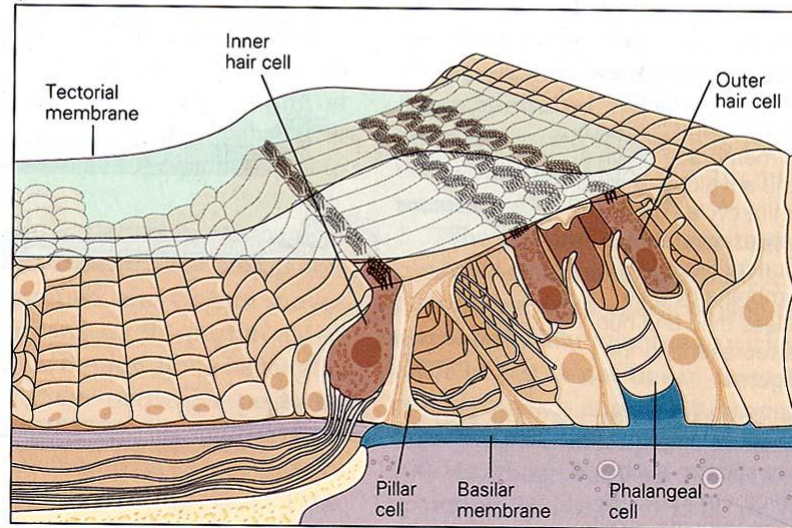




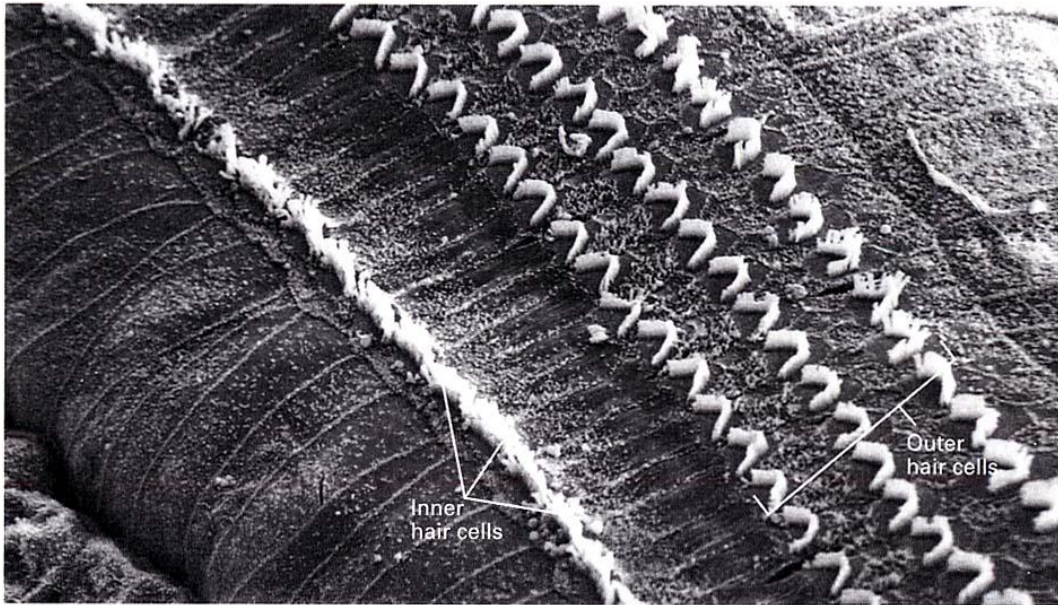
A



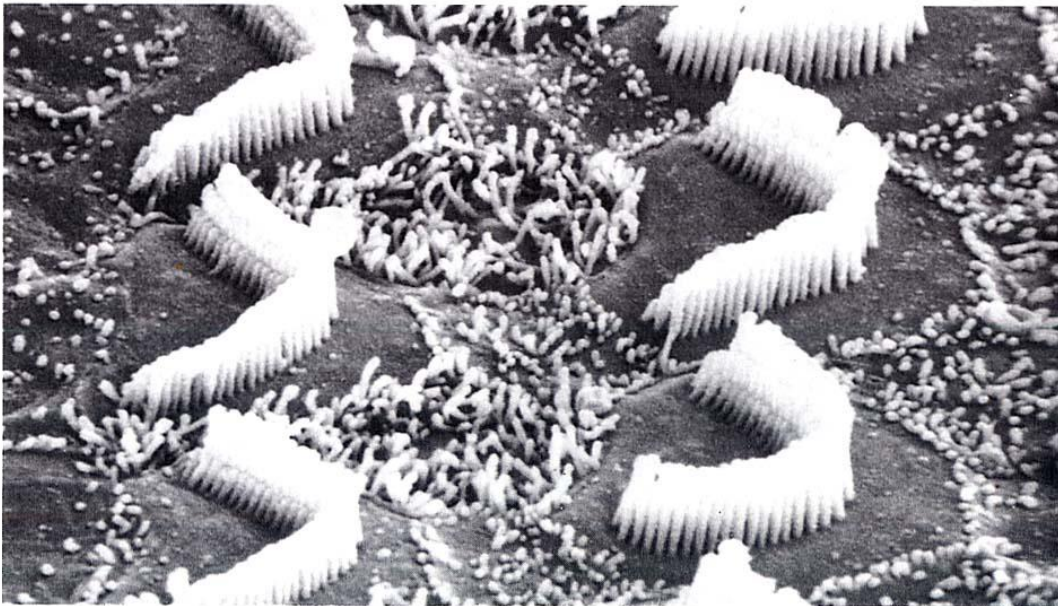
B

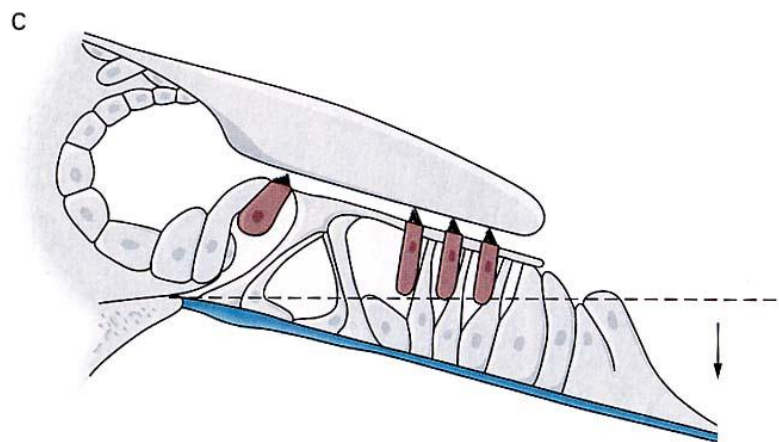
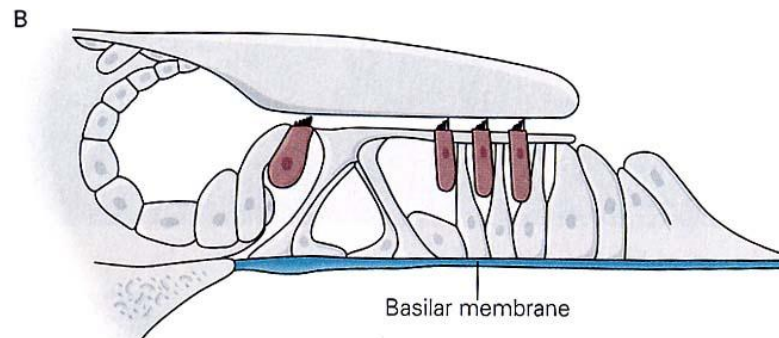
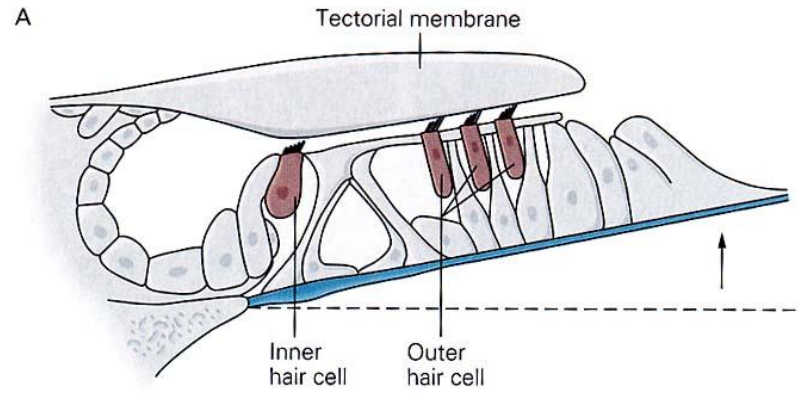


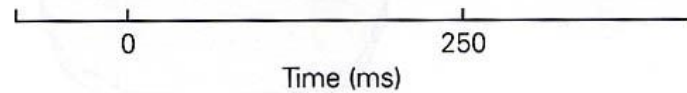
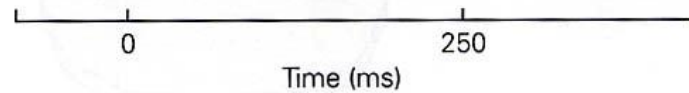
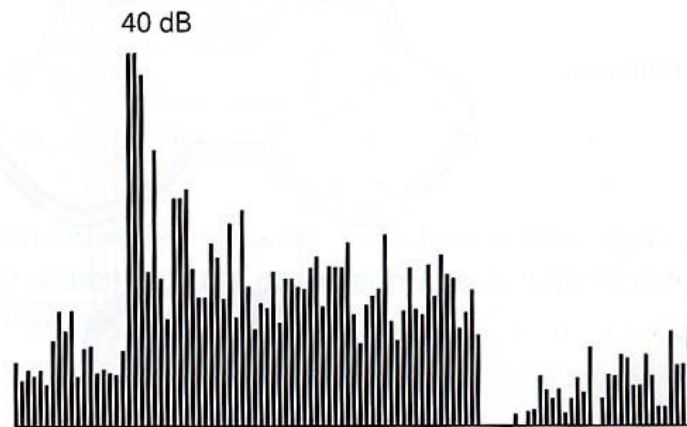
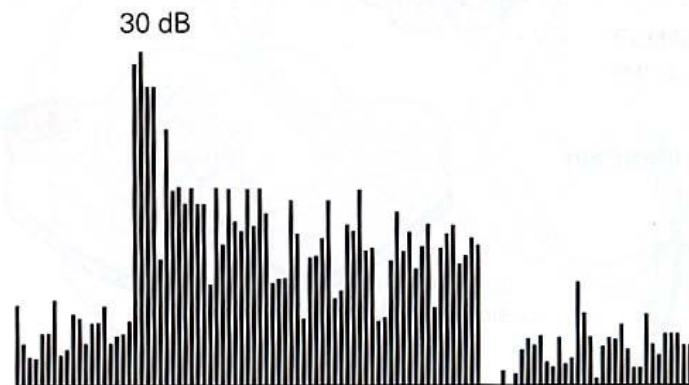
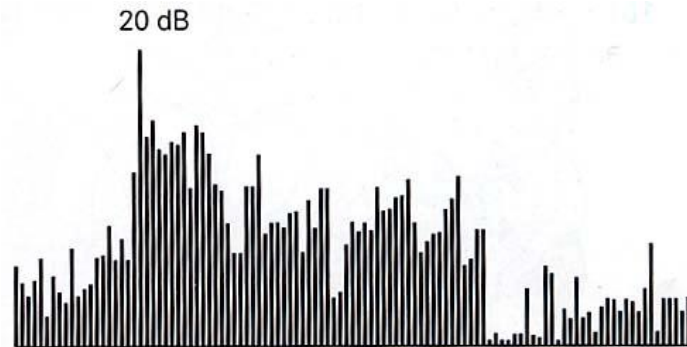
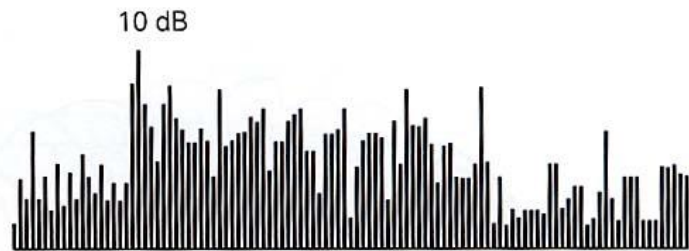
A



B







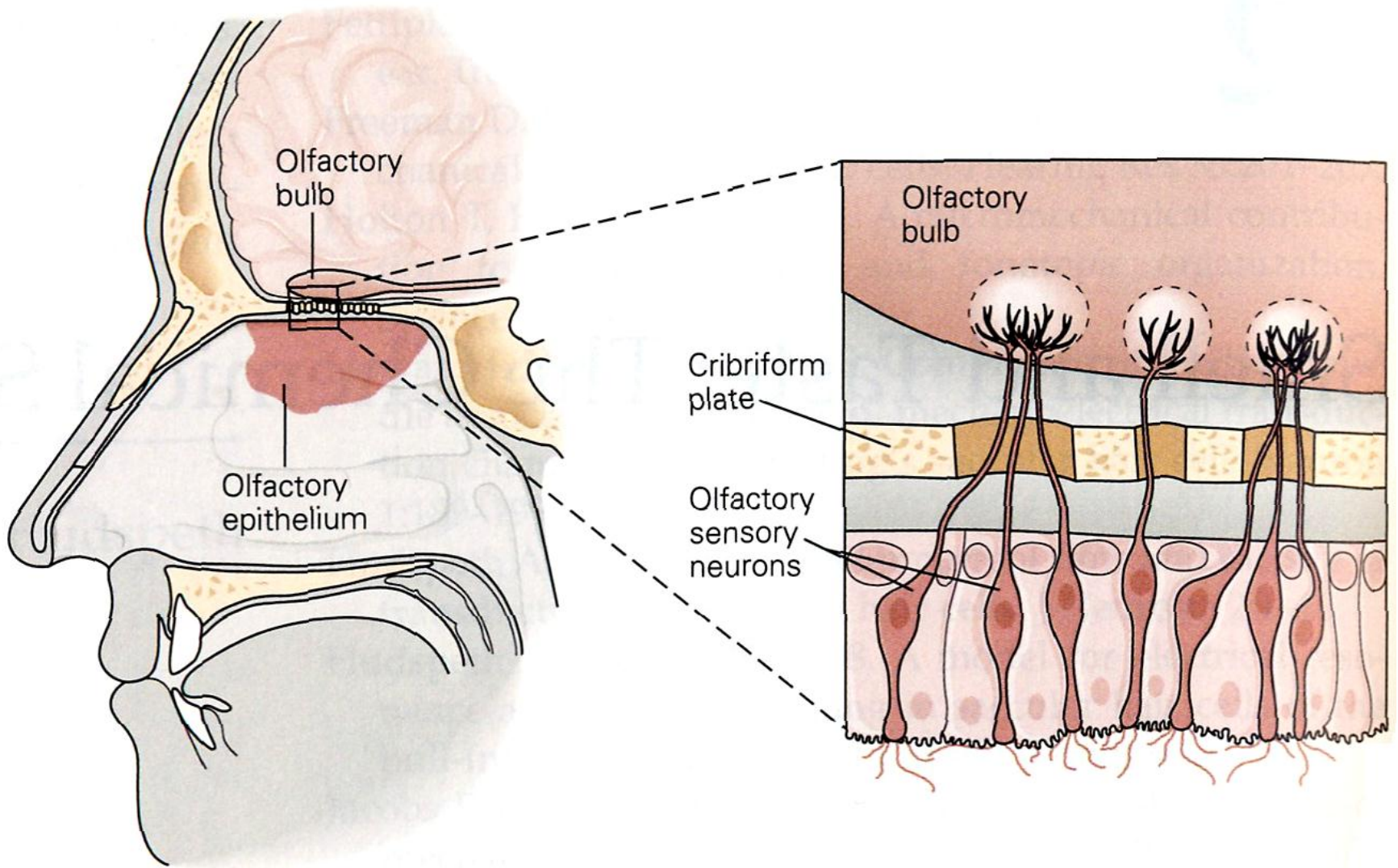
Duration of tone at characteristic frequency

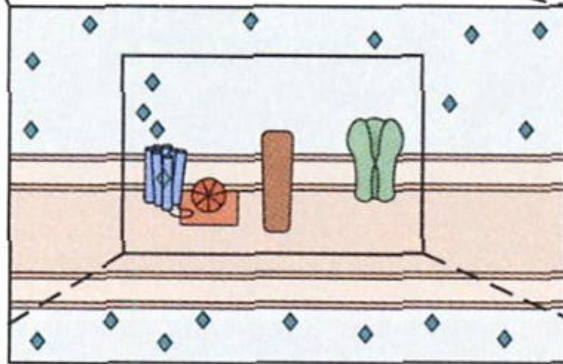
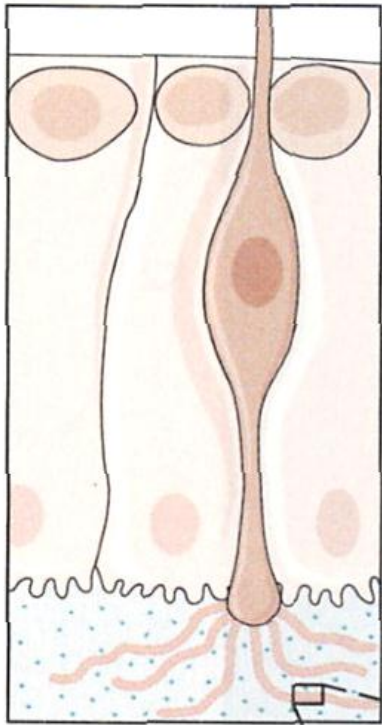


Duration of tone at characteristic frequency

嗅覚

( Olfaction )







味 覚

( Taste )

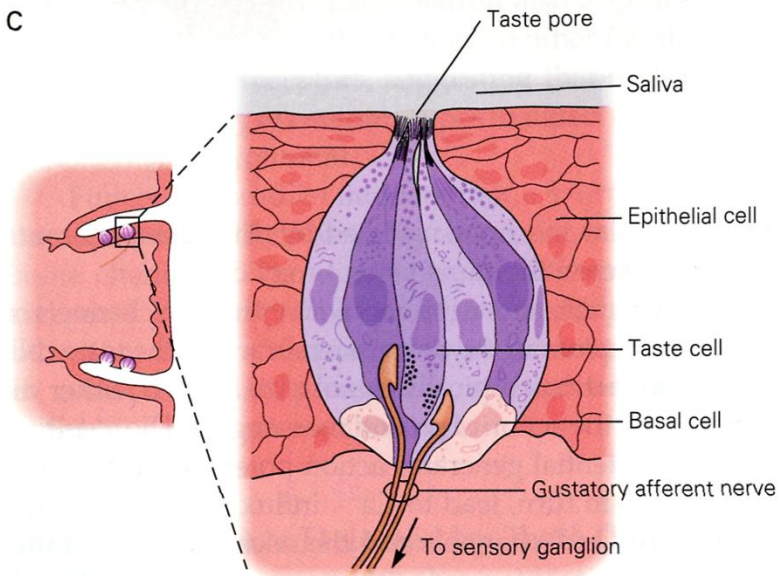
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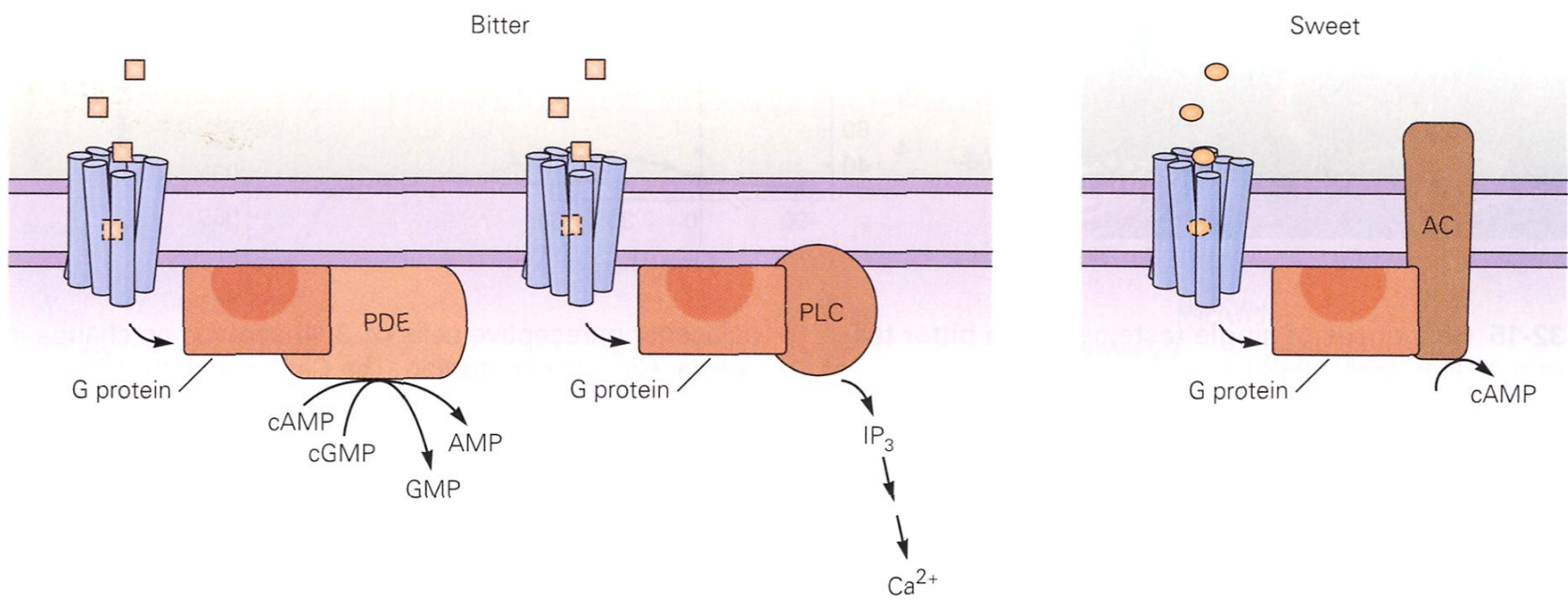
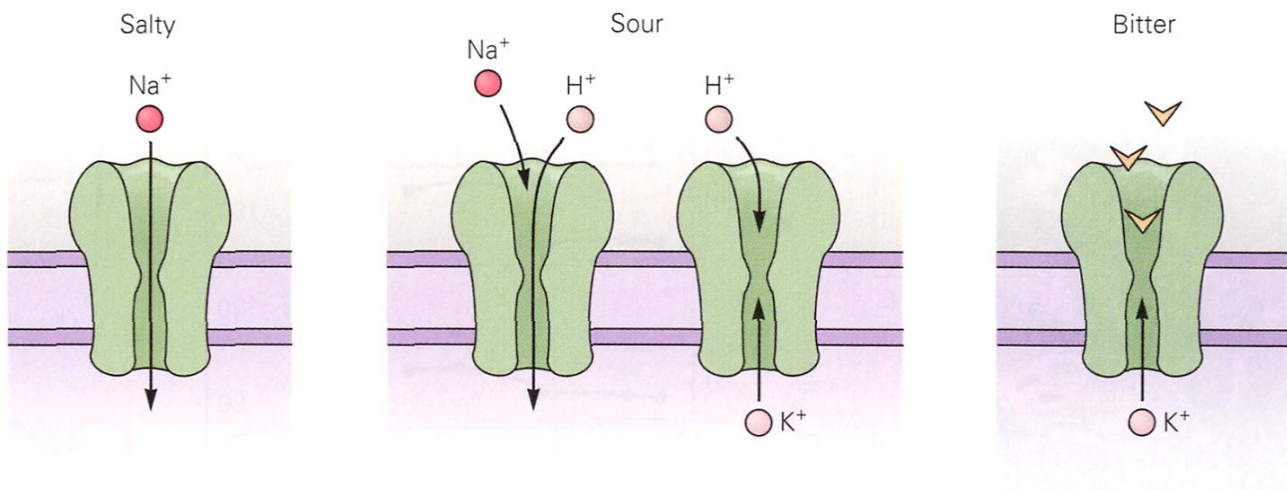


B



C

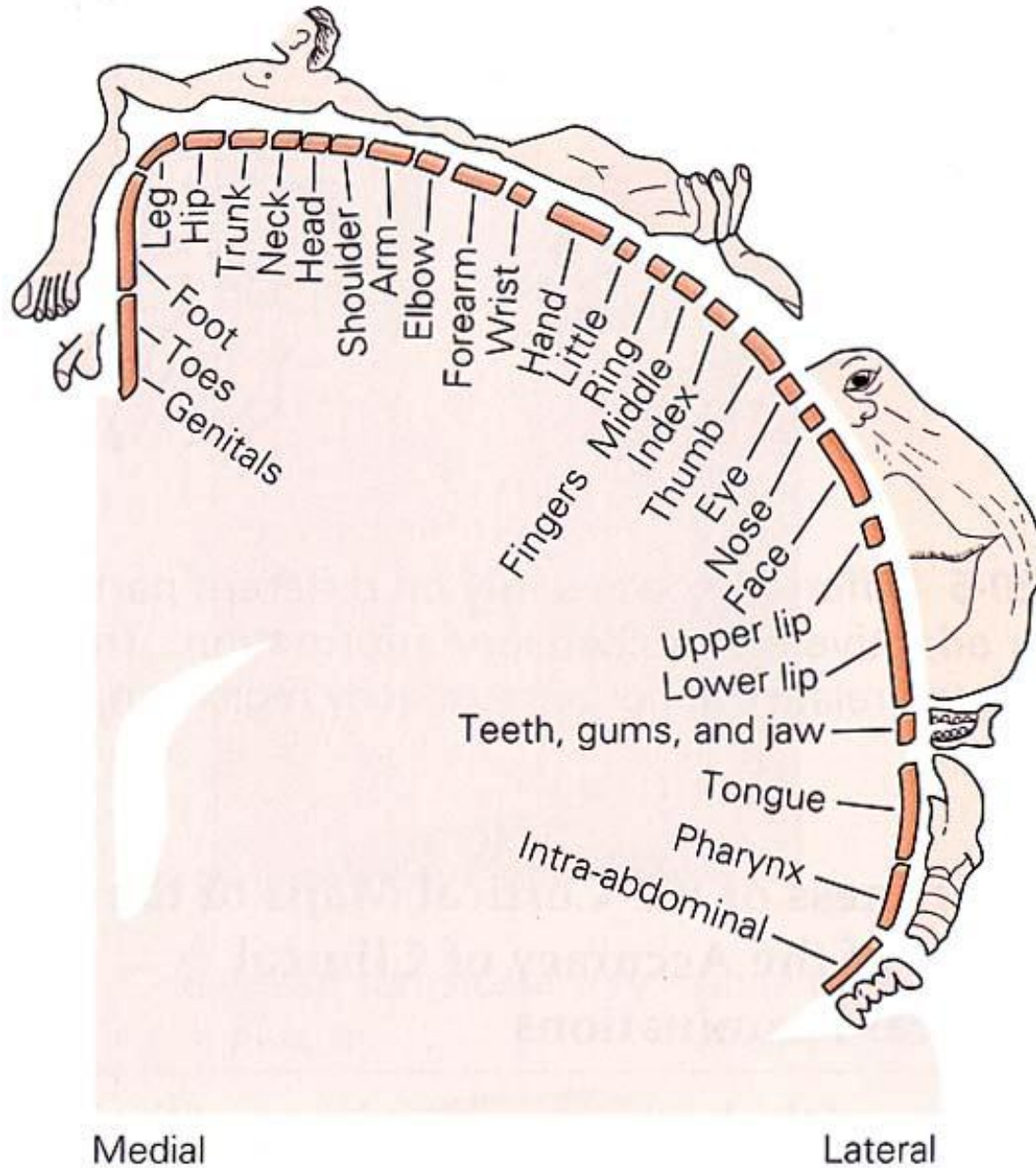




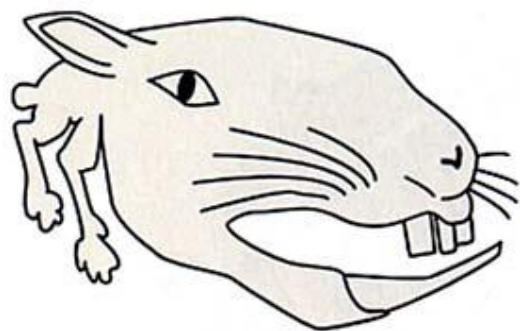
# 体性感觉

( Somatic Sensation )

# Sensory homunculus



Rabbit



Cat



Monkey



Human

