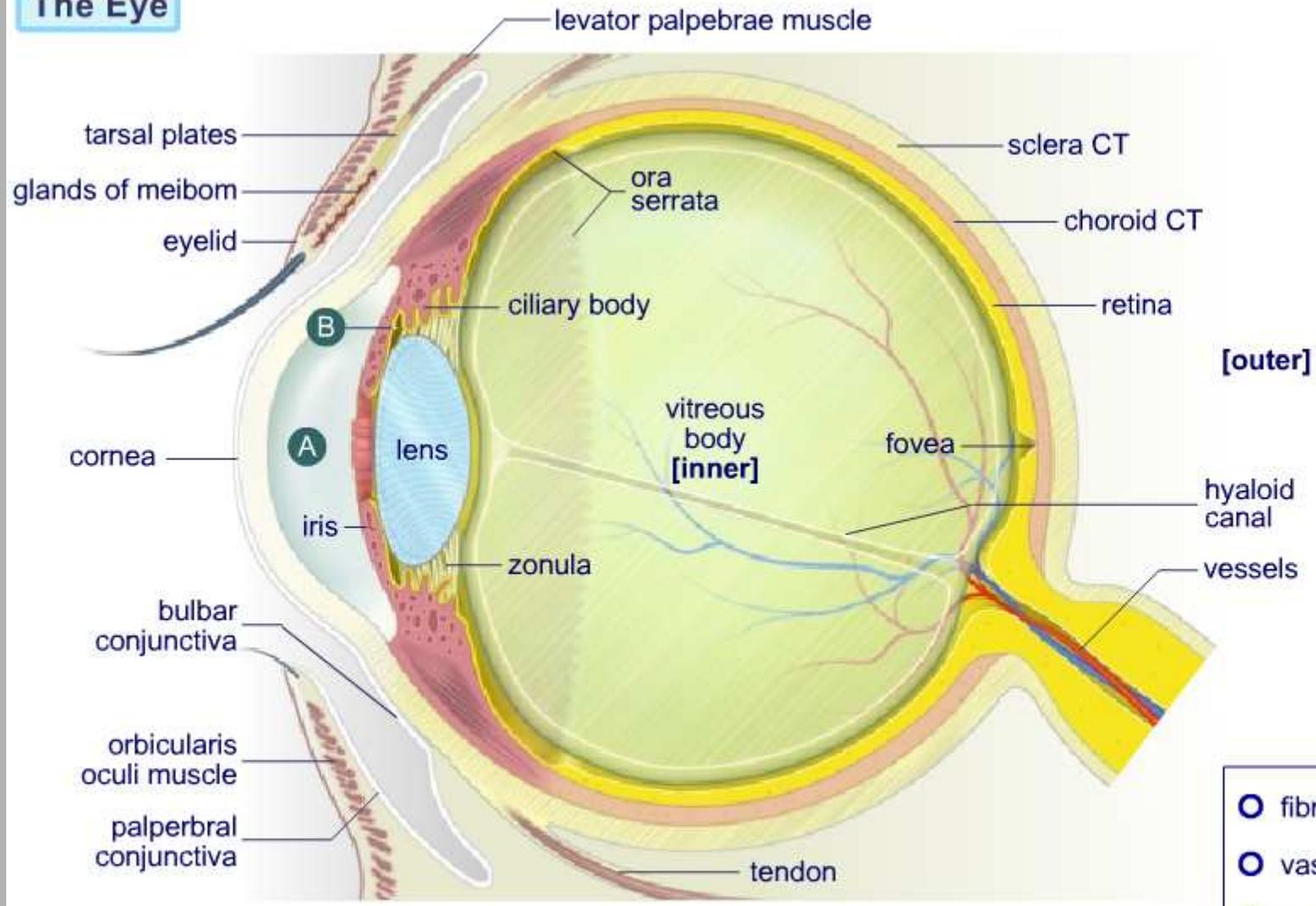


copyright edi.ermes milano

# The Eye

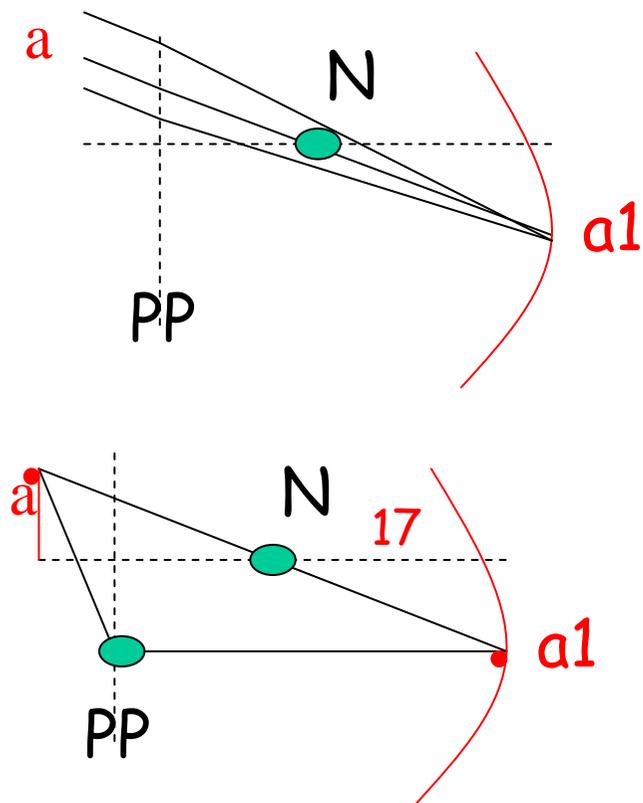
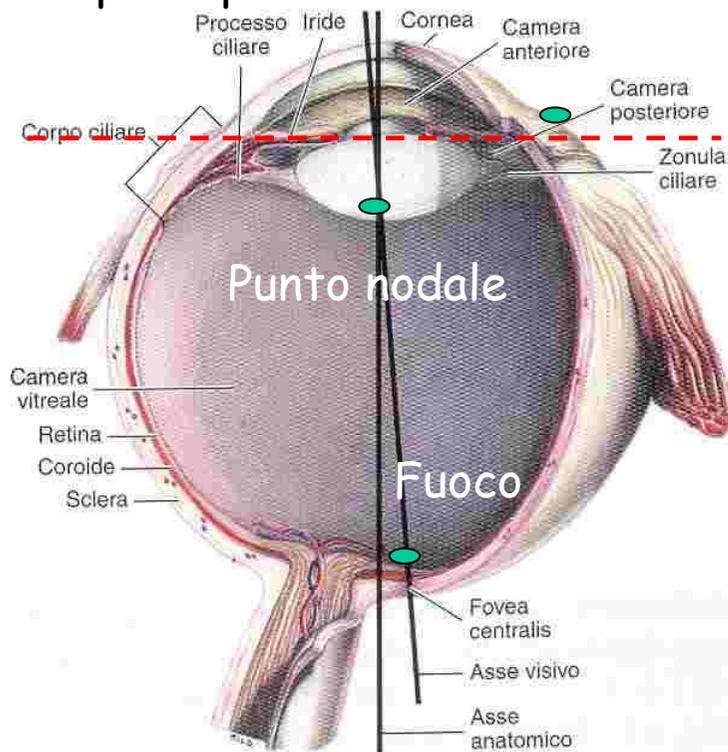


A anterior chamber  
B posterior chamber
 } both chambers contain aqueous humor produced at the level of the ciliary body

- fibrous tunic
- vascular tunic
- neural tunic
- vitreous body (overview)

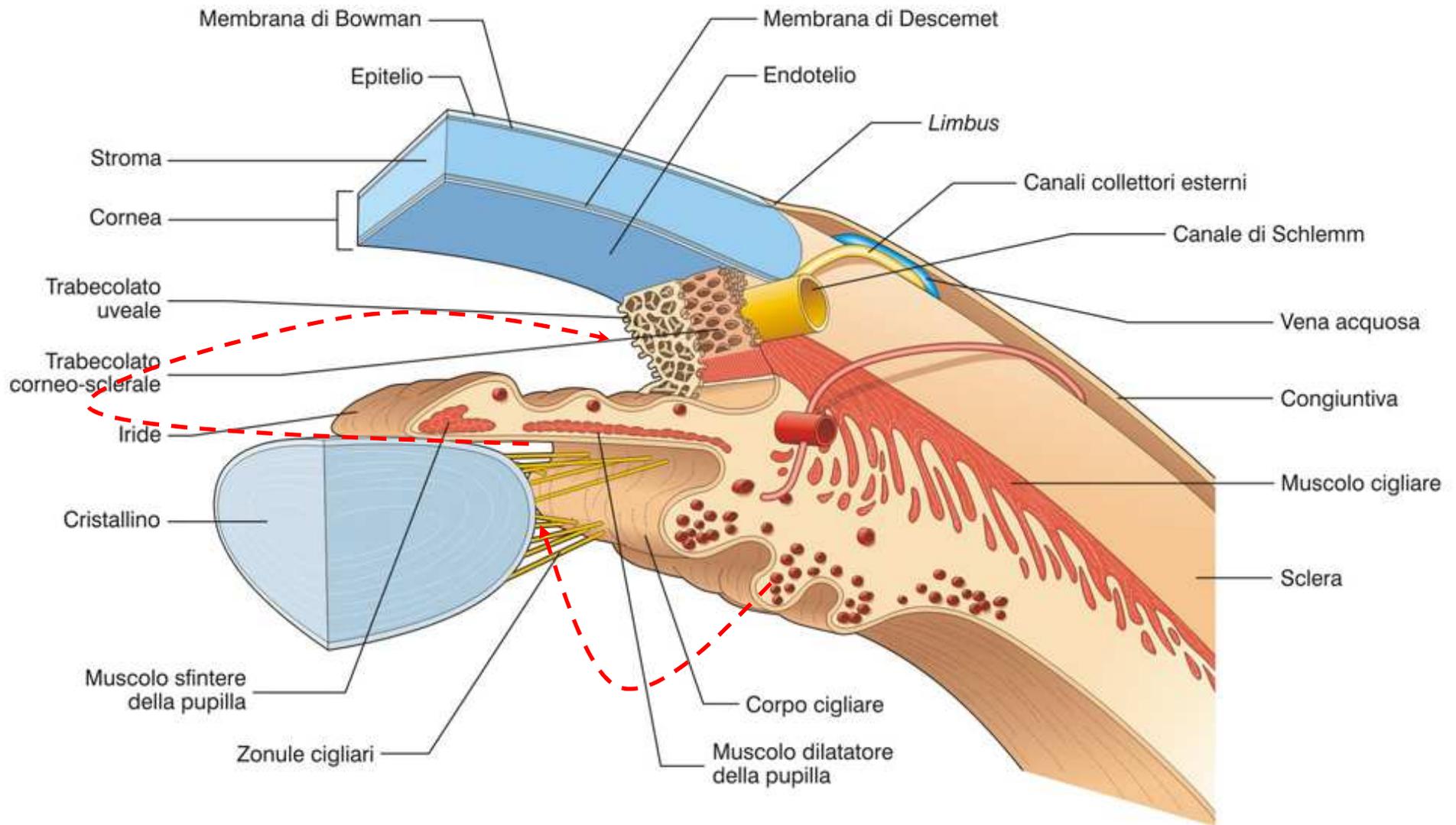
## Asse ottico visivo

Punto e piano principale

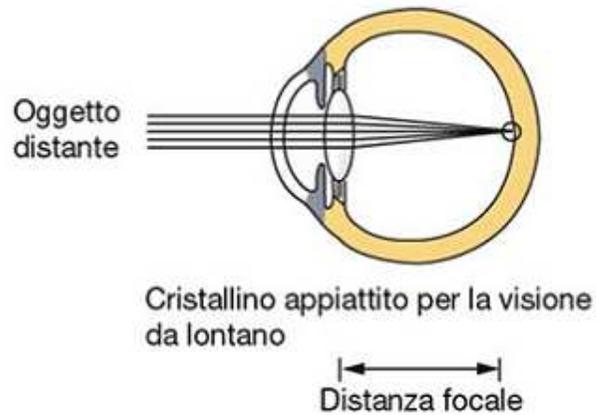
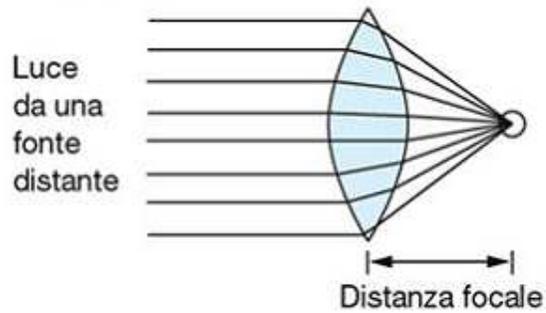


La *diottria* è l'unità di misura della capacità di rifrazione di una lente. E' il reciproco della distanza focale espresso in metri (17 mm)= 59 D

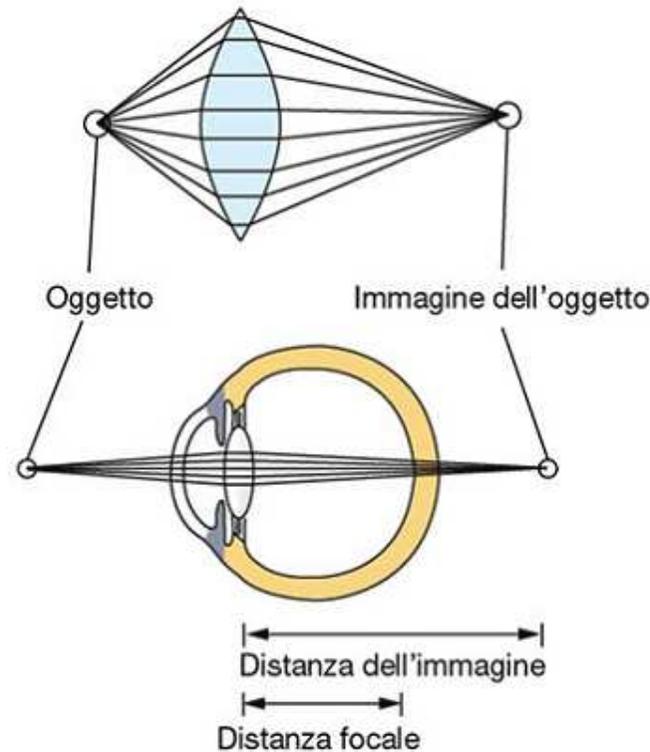
# Umor acqueo



**(a)** Quando i raggi luminosi paralleli passano attraverso il cristallino appiattito, il punto focale cade sulla retina

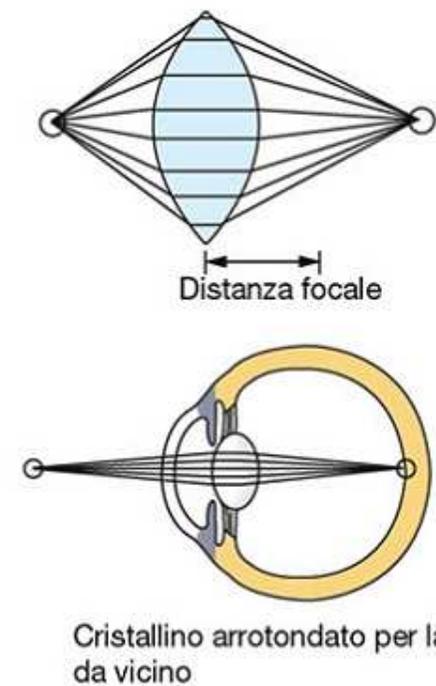


**(b)** Nel caso di oggetti vicini, i raggi luminosi non sono più paralleli.



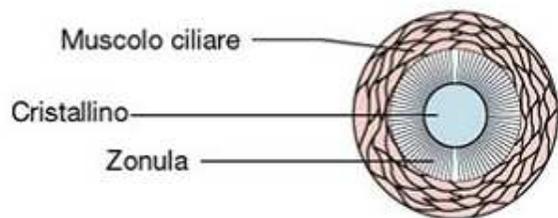
Il cristallino e la sua distanza focale non si sono modificati, ma l'oggetto è visto fuori fuoco perché i raggi luminosi non sono a fuoco sulla retina.

**(c)** Il cristallino arrotondato ha una distanza focale minore.

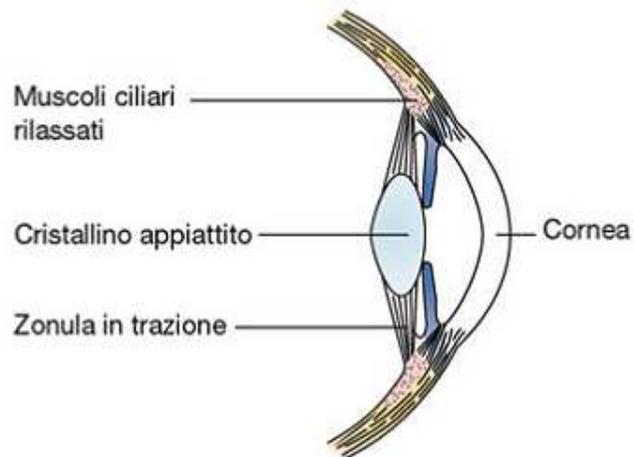


Per mantenere a fuoco un oggetto mentre si avvicina, il cristallino si arrotonda.

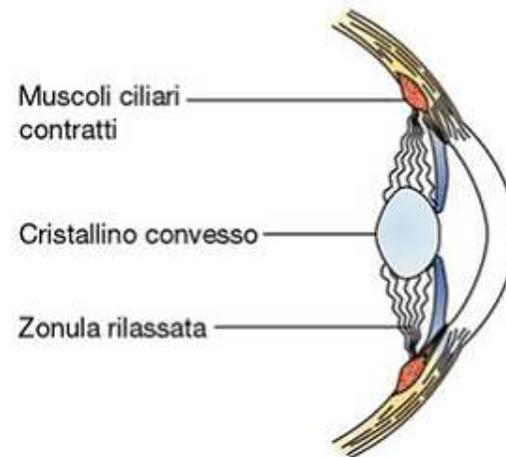
**(a)** Il cristallino è collegato al muscolo ciliare da fibre anelastiche, dette collettivamente zonula.

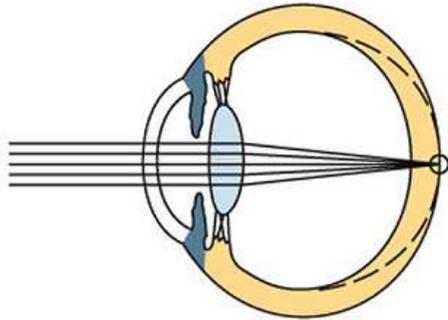


**(b)** Quando il muscolo ciliare è rilassato, la zonula tira sul cristallino e lo mantiene appiattito.

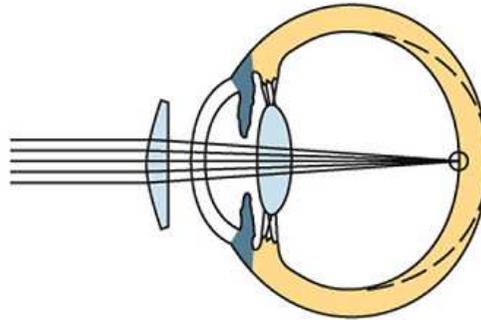


**(c)** Quando il muscolo è contratto, diminuisce la tensione sulla zonula, e il cristallino, che è elastico, assume una forma più rotonda.

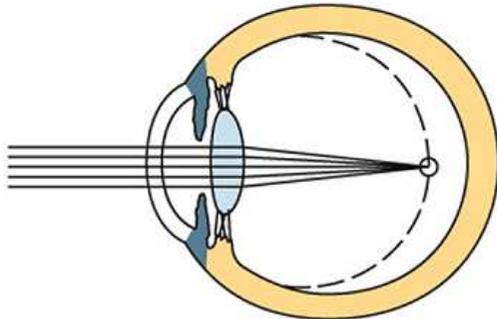




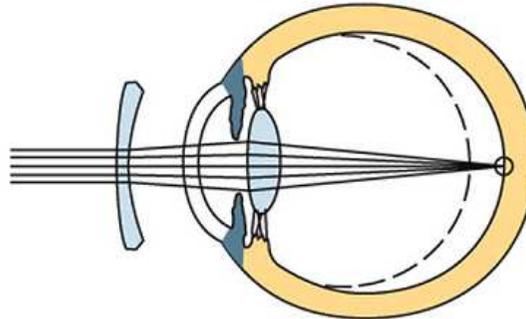
**(a) L'ipermetropia**, cioè il vedere male da vicino, si verifica quando l'occhio è troppo corto e il punto focale cade dietro alla retina.



Ipermetropia (corretta con una lente convessa)



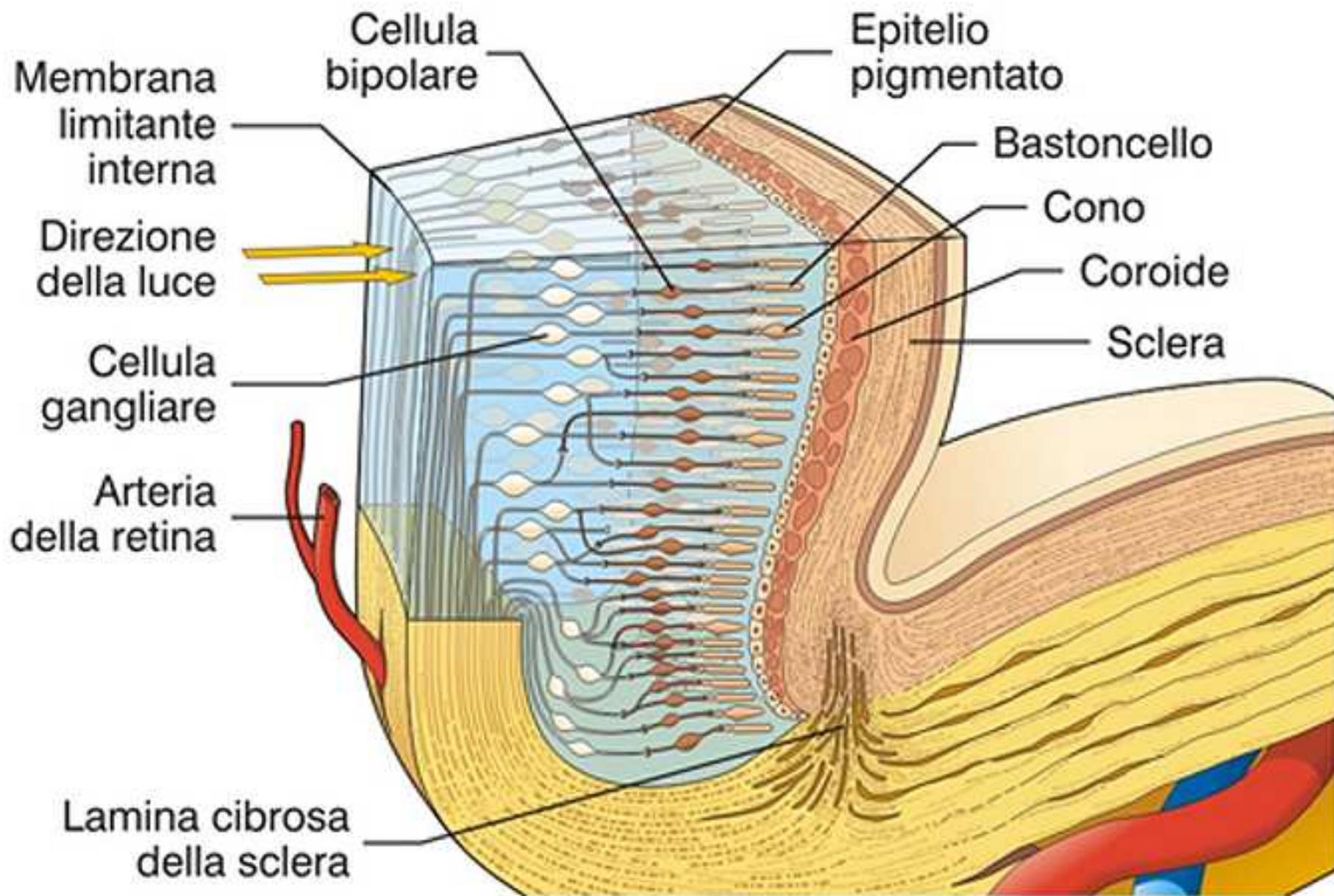
**(b) La miopia**, cioè il vedere male da lontano, si verifica quando l'occhio è troppo lungo e il punto focale cade davanti alla retina.



Miopia (corretta con una lente concava)

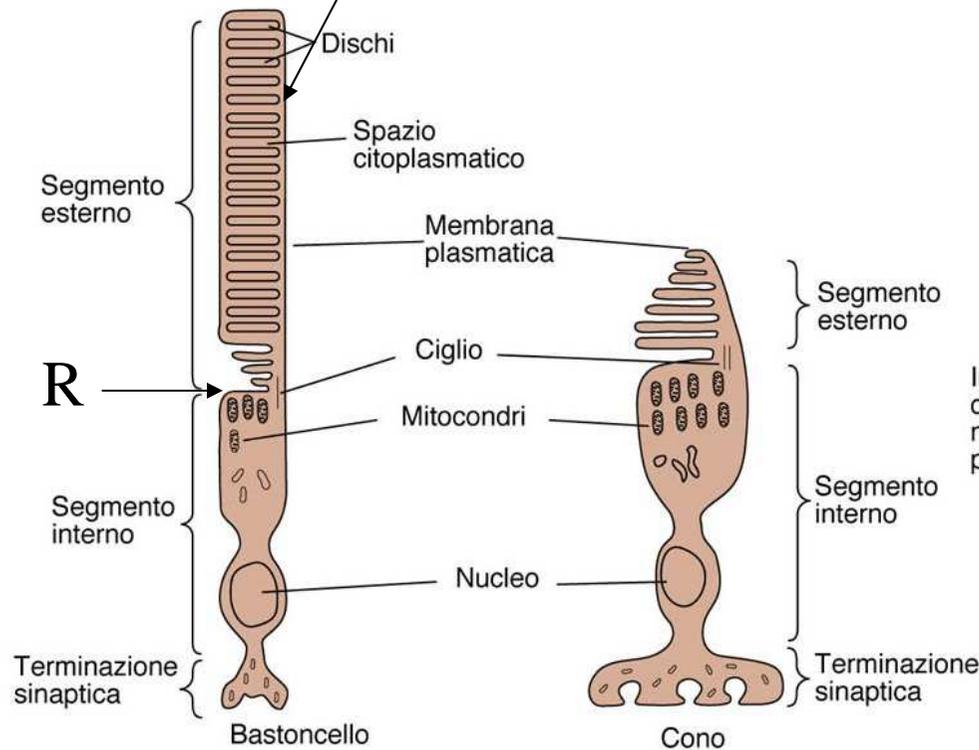
*+ Astigmatismo*

L'aberrazione cromatica dipende dal fatto che la luce di differente lunghezza d'onda viene diversamente rifratta da una lente. Per questo motivo una scritta rossa (lunghezza d'onda elevata) su uno sfondo blu (lunghezza d'onda breve) crea problemi di messa a fuoco (o si mette a fuoco il rosso, o il blu), e si legge con difficoltà.



# Crescita continua

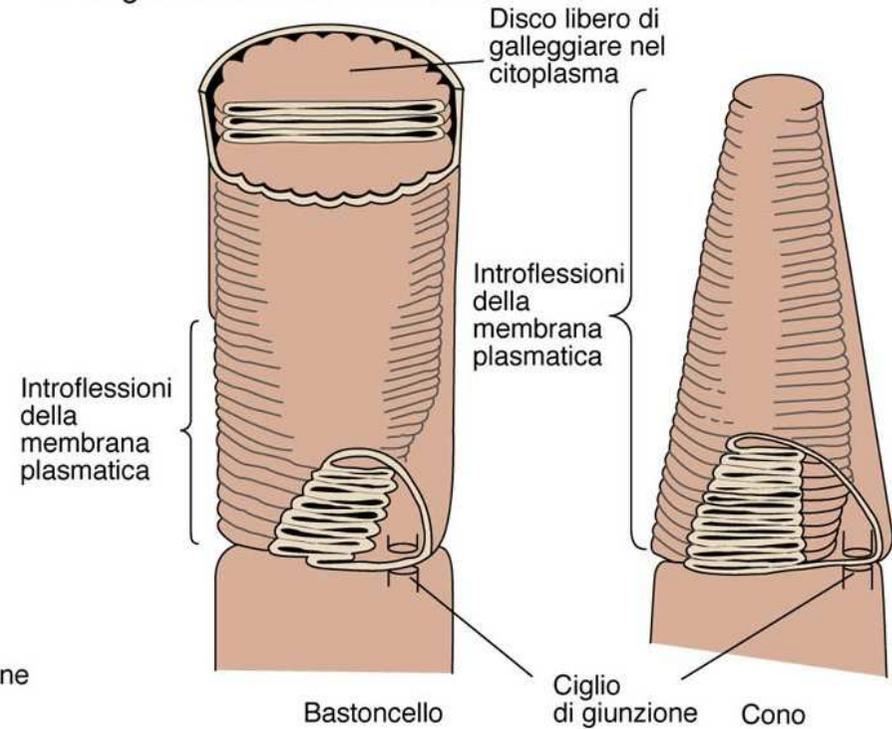
**A** Morfologia dei fotorecettori



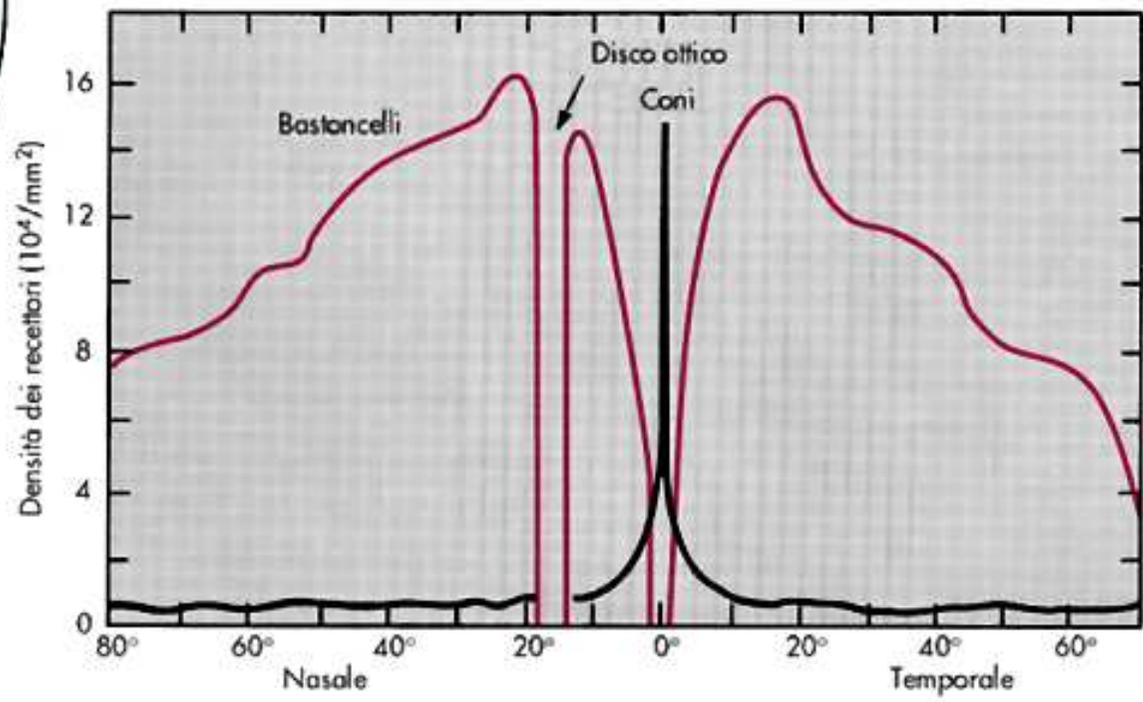
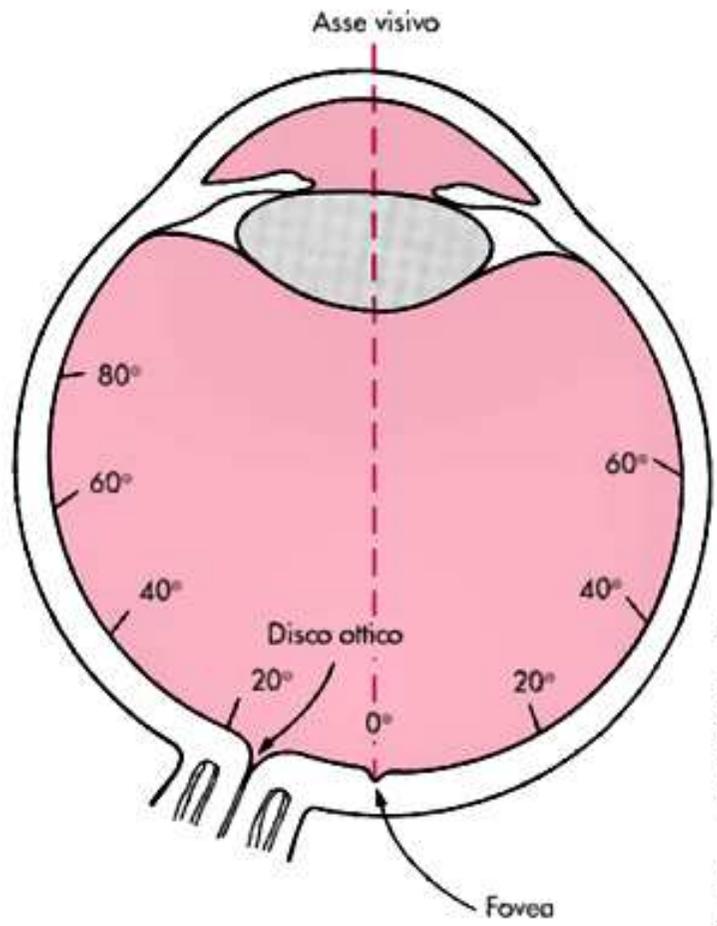
**Sensibilità**  
**Risol. Temp.**  
**Acuità**  
**Colori**

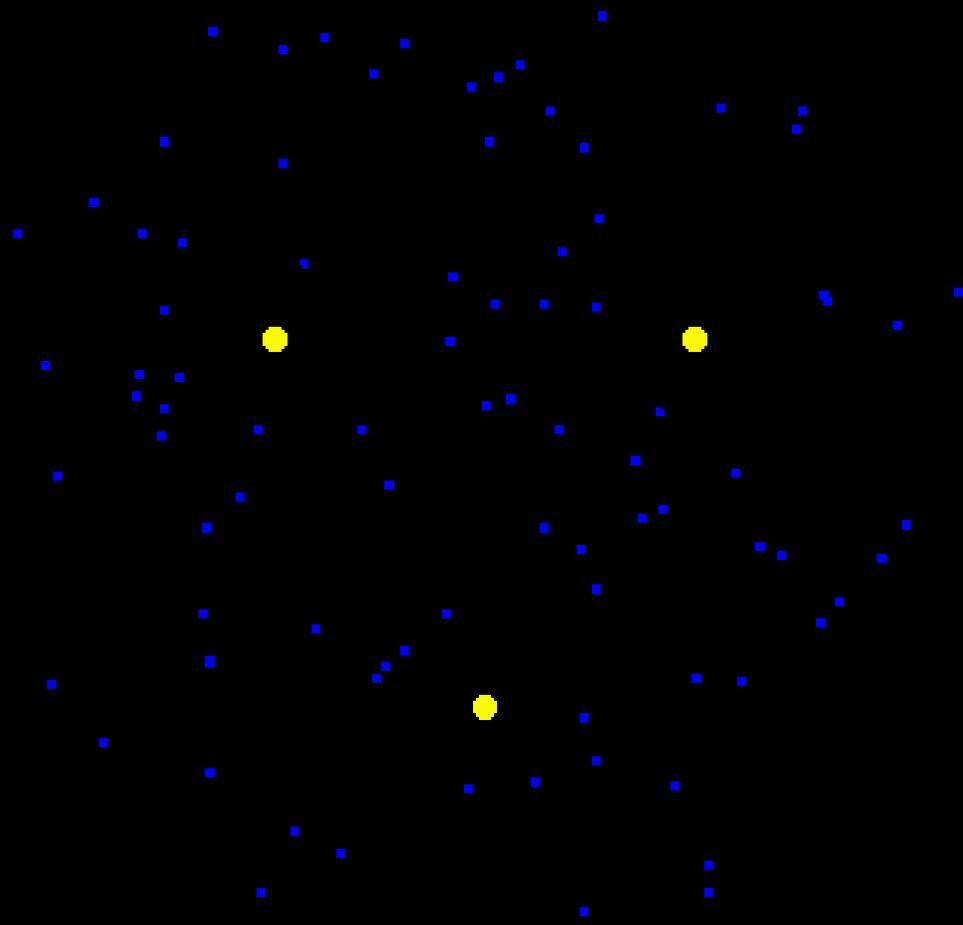
**Bassa**  
**Elevata**  
**Elevata**  
**Cromatica**

**B** Segmento esterno dei fotorecettori



**Alta**  
**Bassa**  
**Bassa**  
**Acromatica**





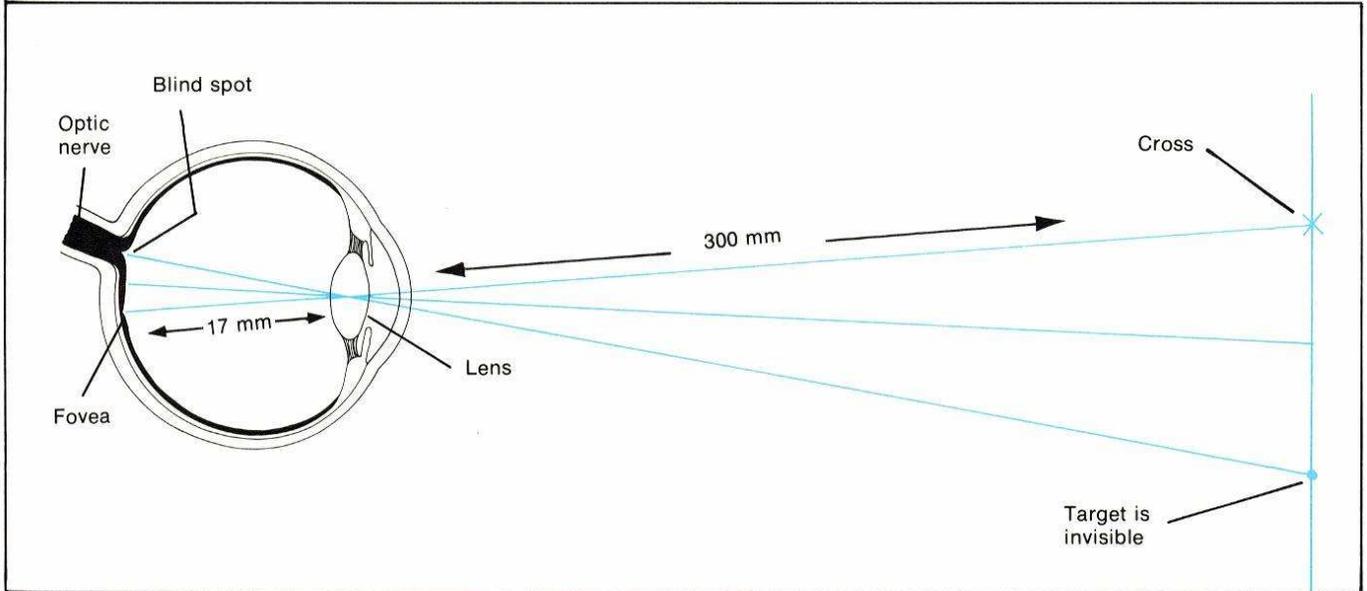
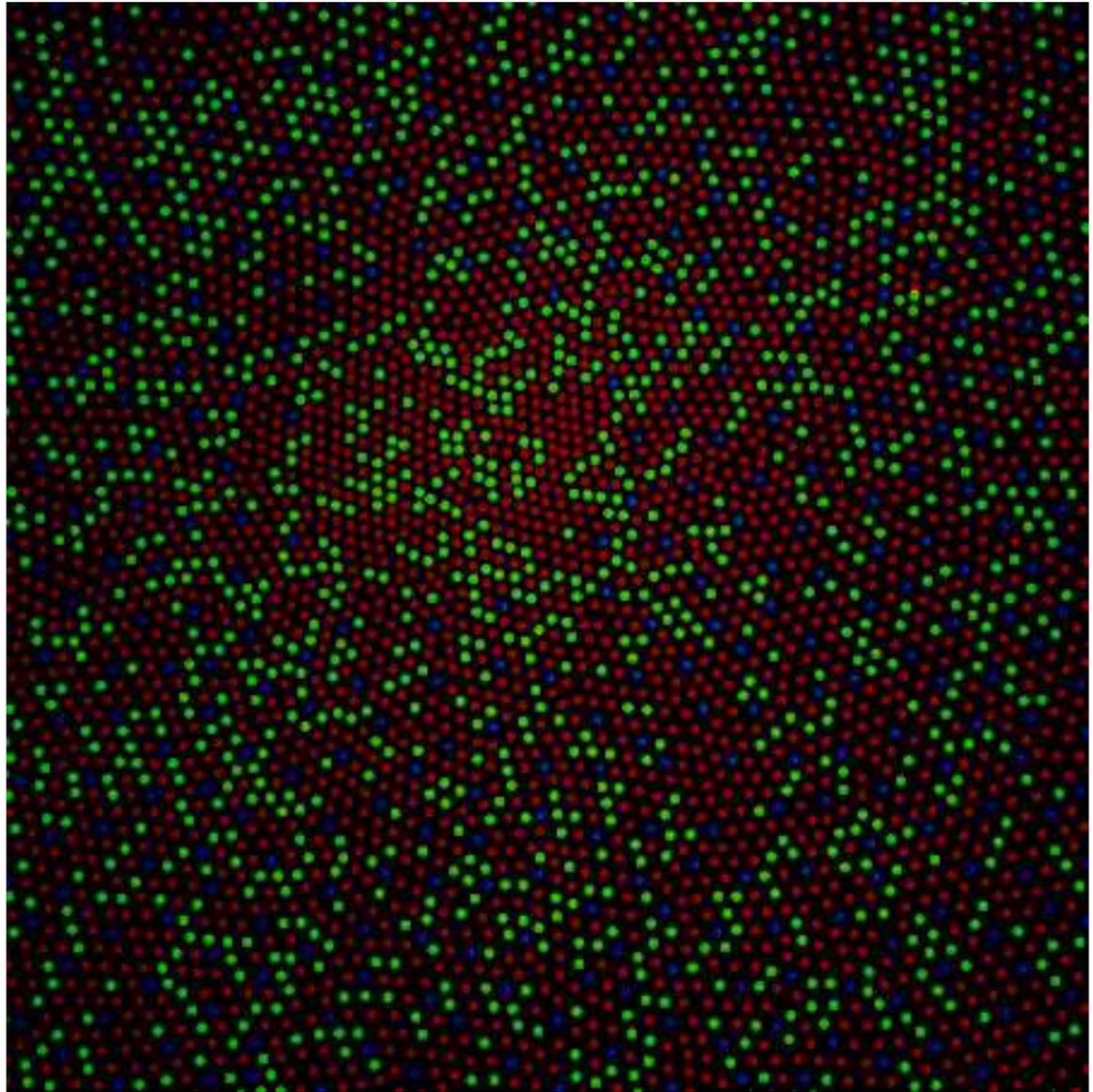
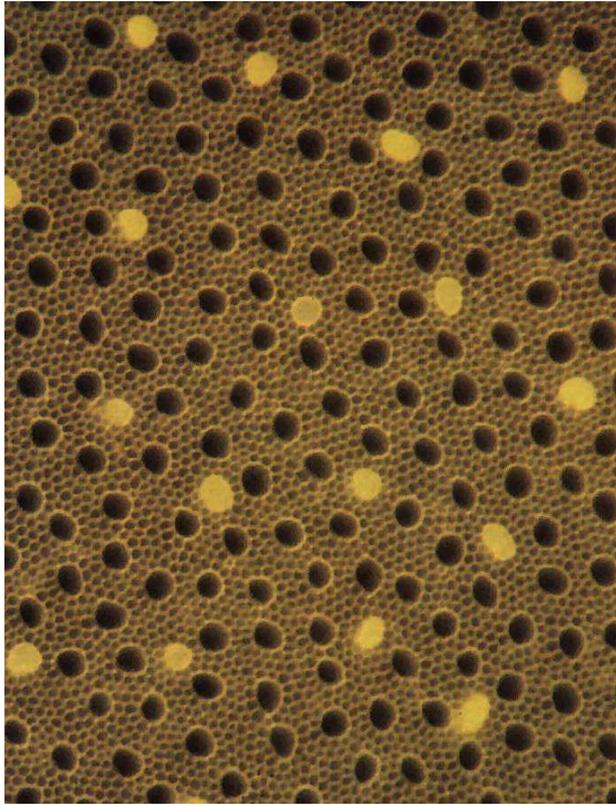
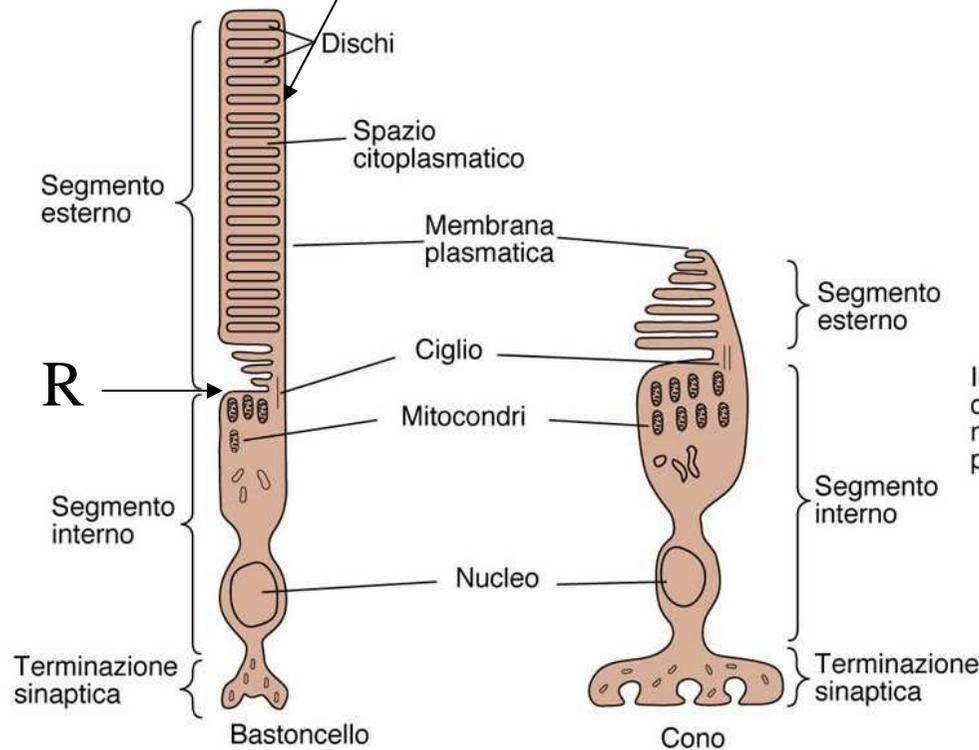


Figure 23 Determining the size of the visual blind field.



# Crescita continua

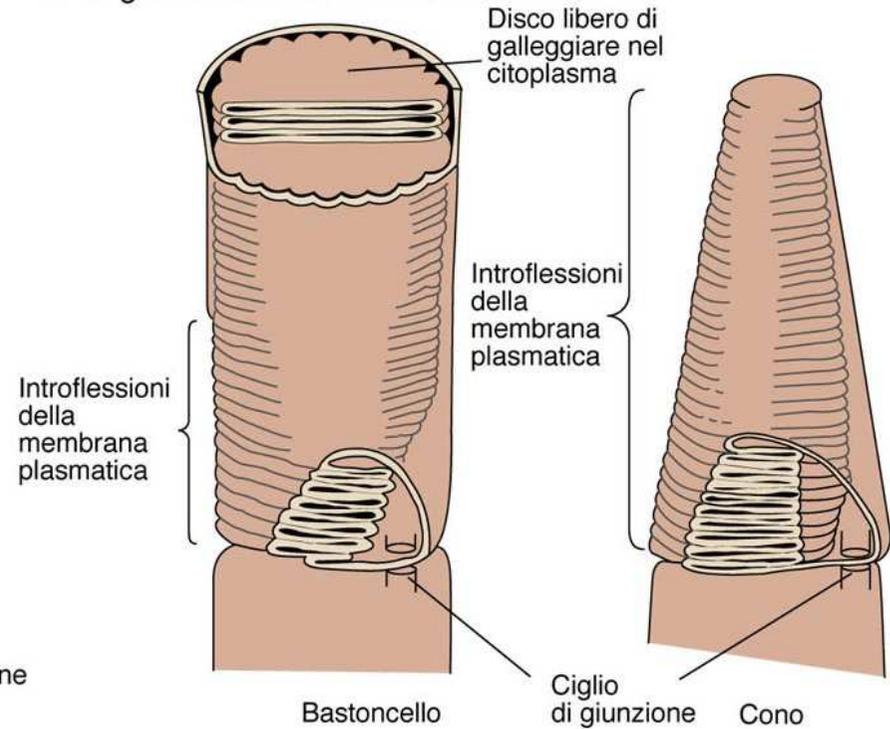
**A** Morfologia dei fotorecettori



**Sensibilità**  
**Risol. Temp.**  
**Acuità**  
**Colori**

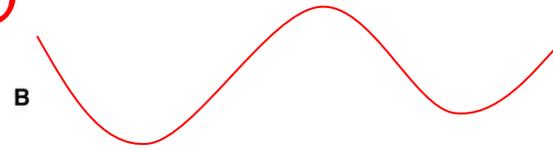
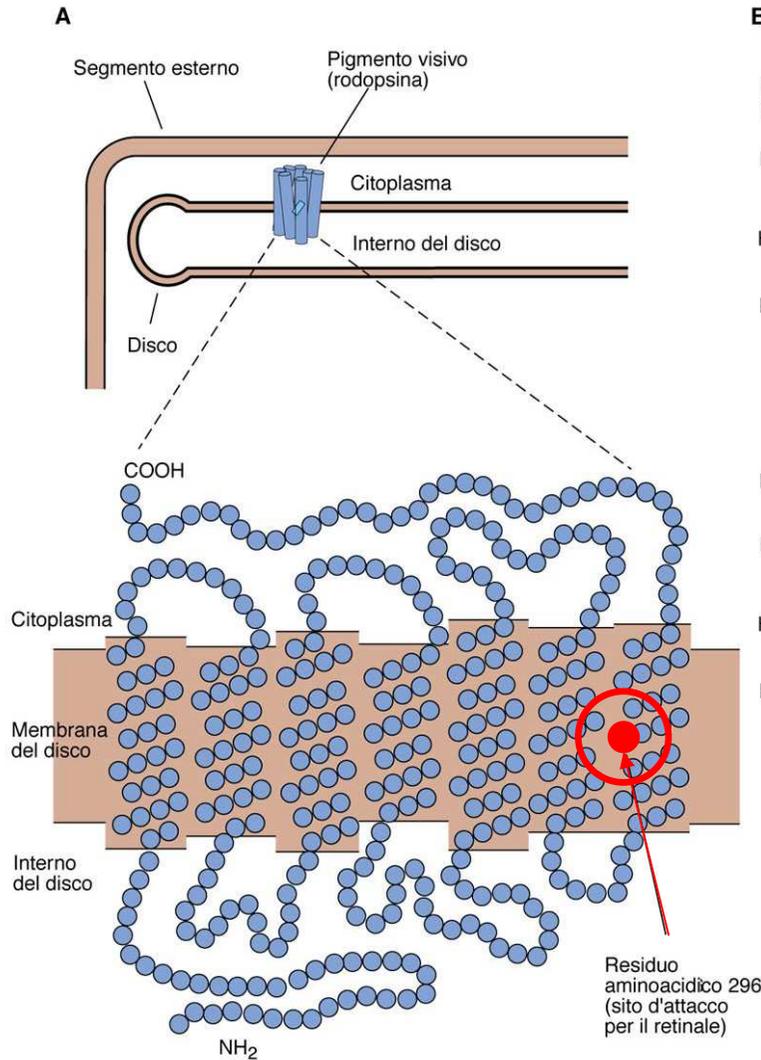
**Bassa**  
**Elevata**  
**Elevata**  
**Cromatica**

**B** Segmento esterno dei fotorecettori

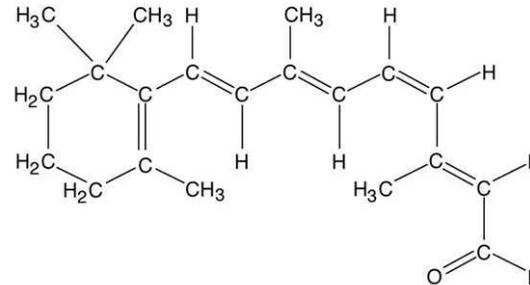


**Alta**  
**Bassa**  
**Bassa**  
**Acromatica**

# Interazione luce - pigmento

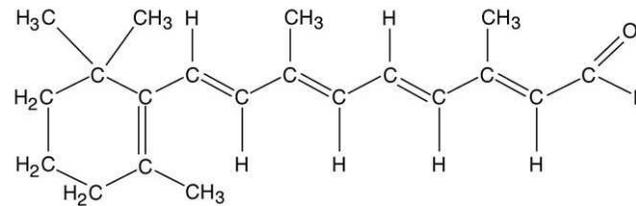


Retinale 11-*cis*  
 (M<sub>r</sub> = 268)



*CIS*

Retinale tutto-*trans*



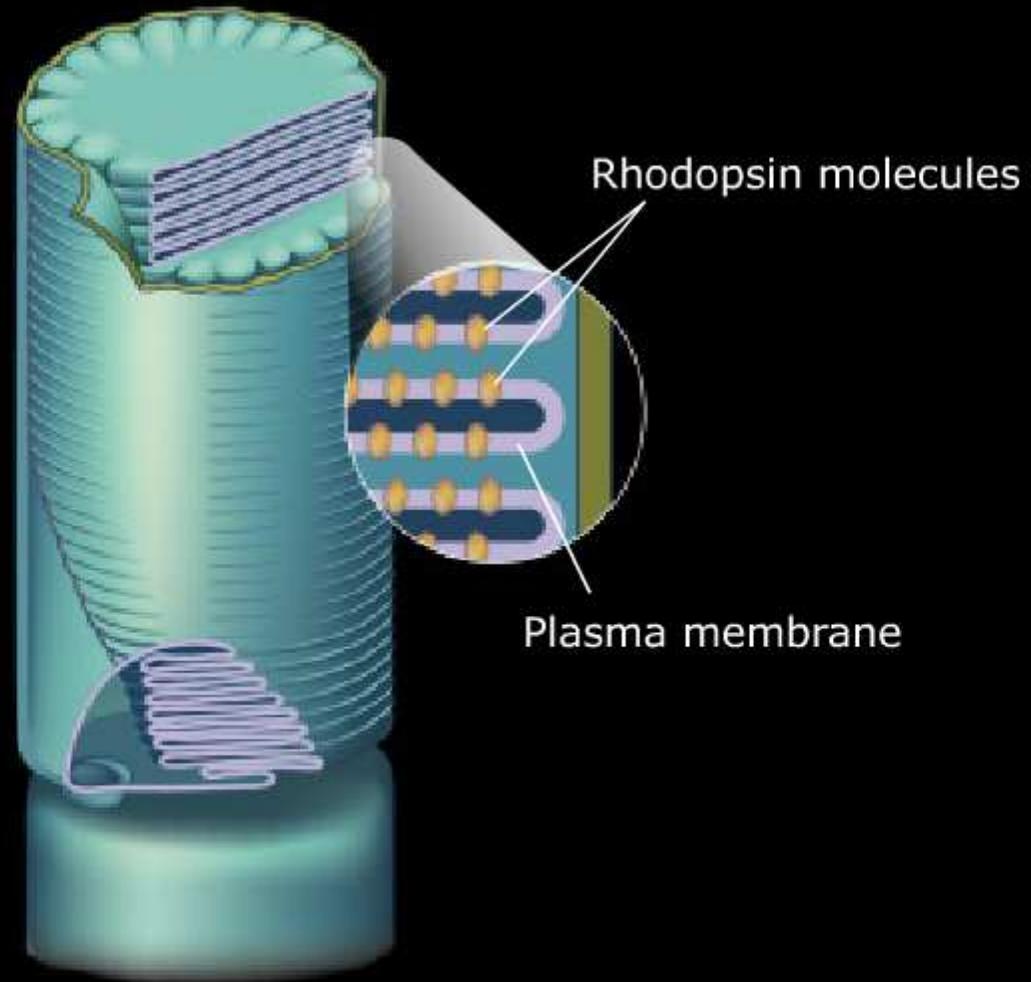
*Trans*

*Rodopsina = L onda 510 nm*

Rodopsina → Metarodopsina I-II → Retinaldeide + Opsina → Retinolo ← Fegato

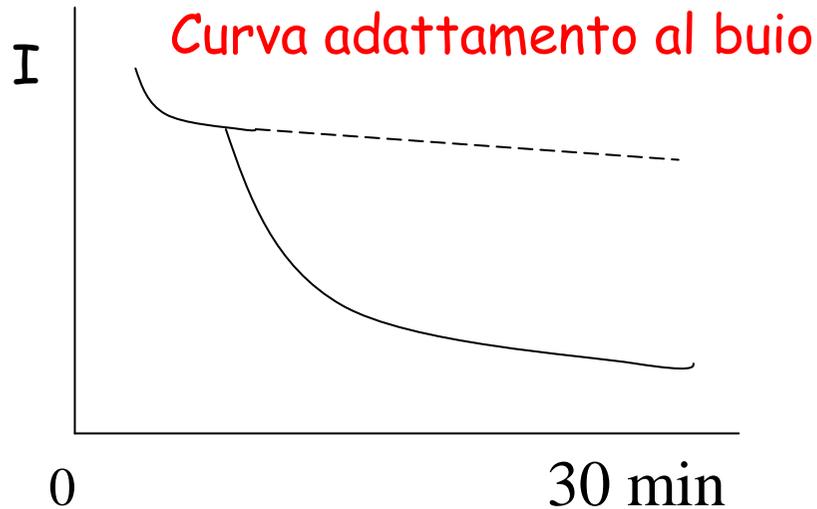
# Photoisomerization of rhodopsin

Outer segment  
of rod



Loading animation

## Pigmenti: visione fotopica e scotopica



**Bastoncelli Rodopsina: 510**

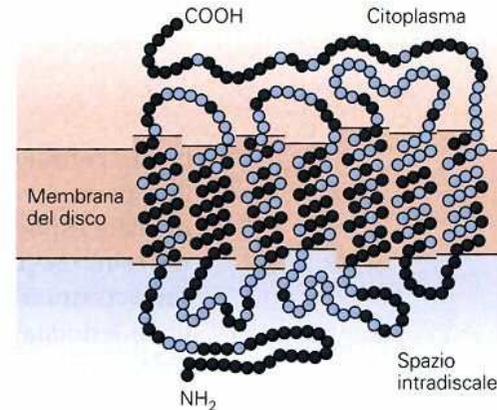
**Coni**

**M = clorolabe verde 530 (verde-blu)**

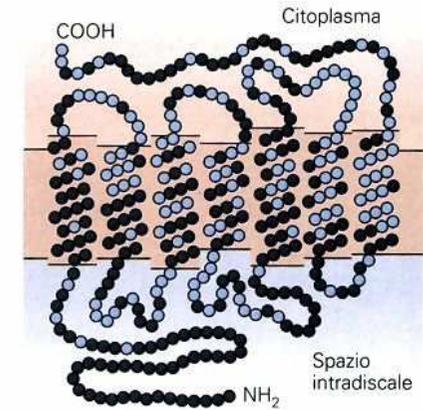
**L = eritrolabe rosso (verde-giallo) 560**

**S = cianolabe blu 430**

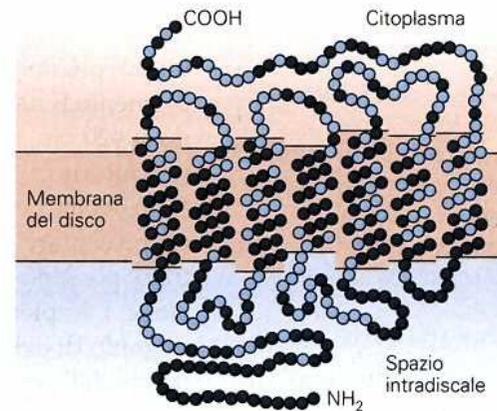
Confronto coni S e rodopsina



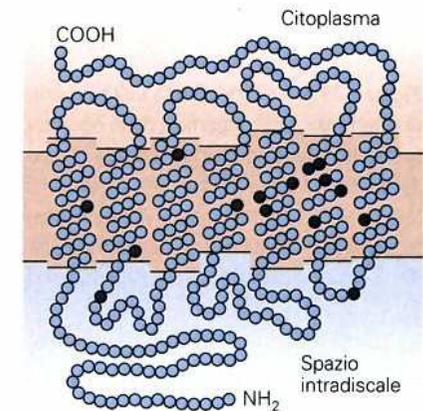
Confronto coni M e rodopsina

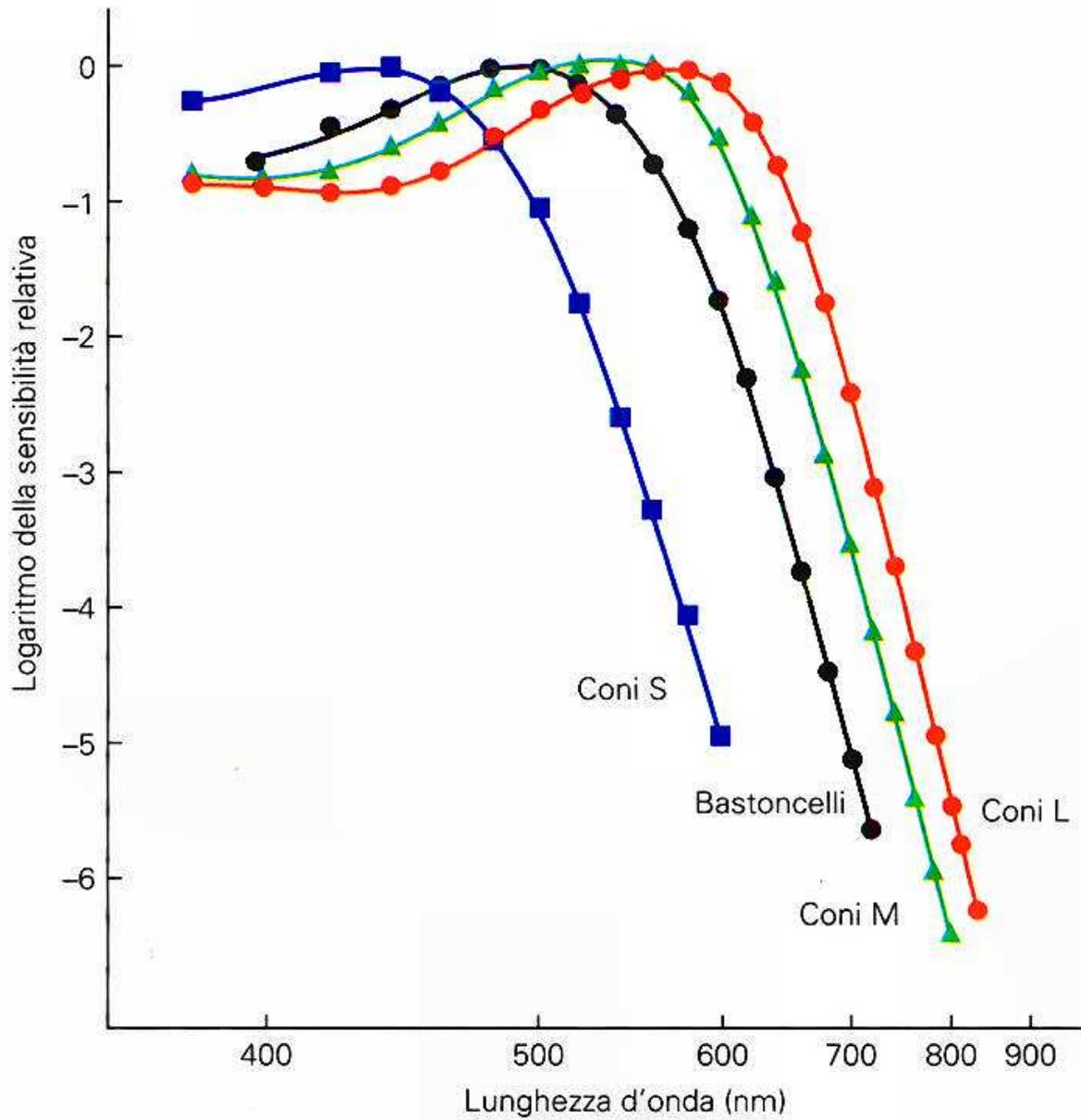


Confronto coni M e coni S

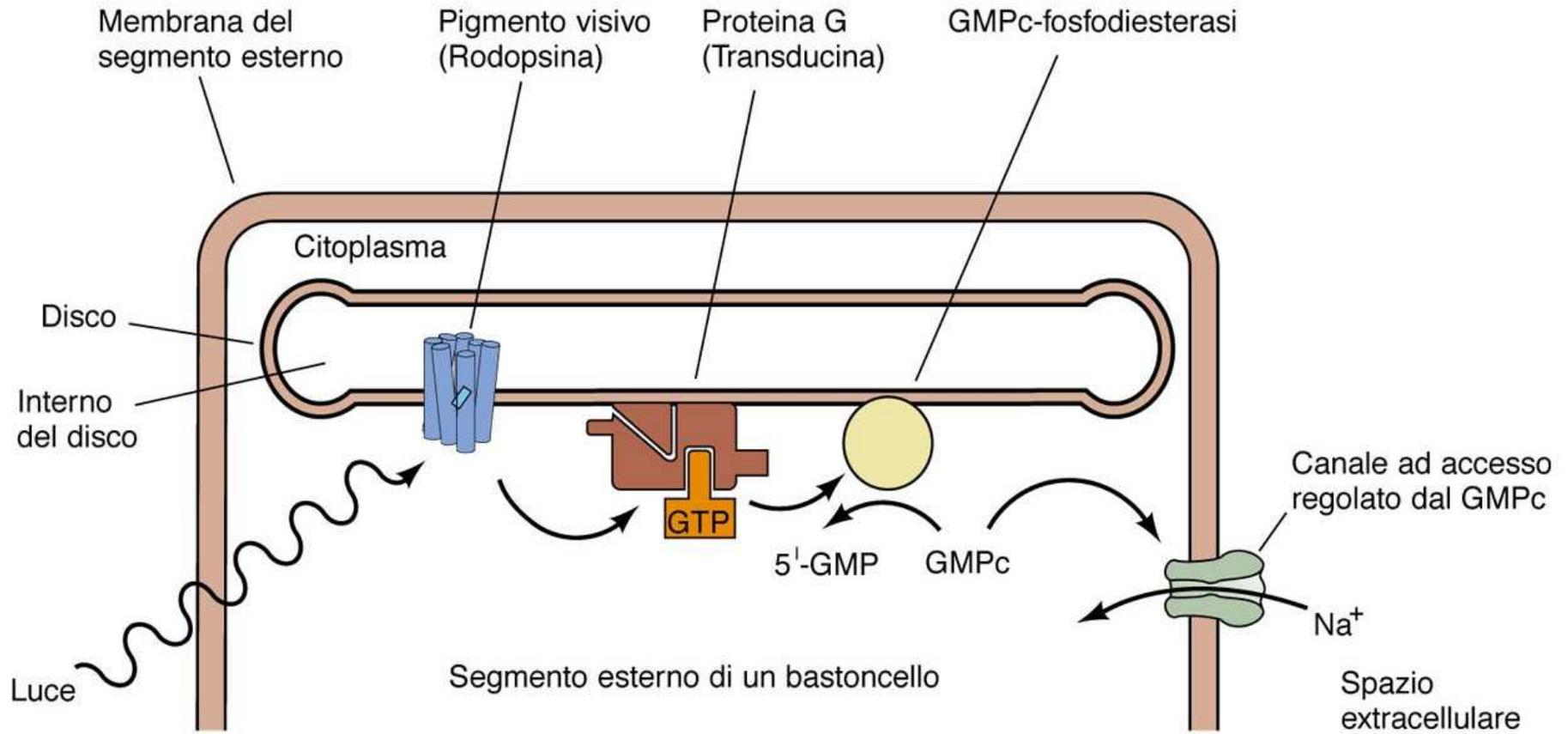


Confronto coni L e coni M

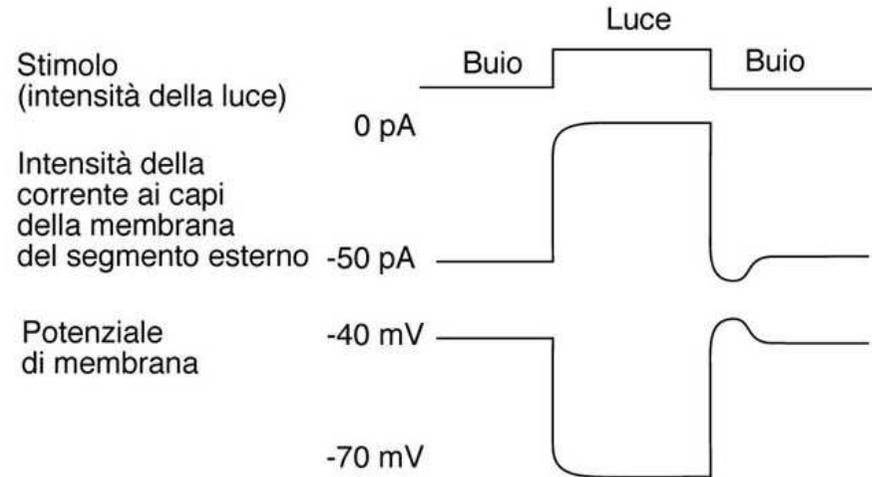
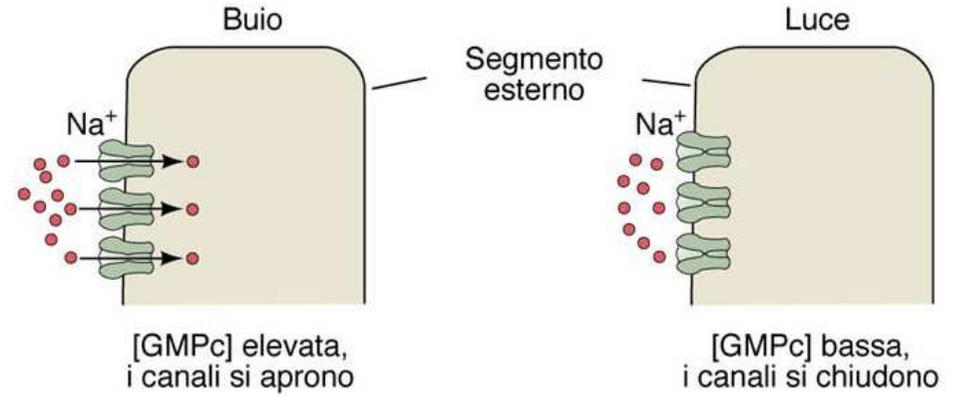
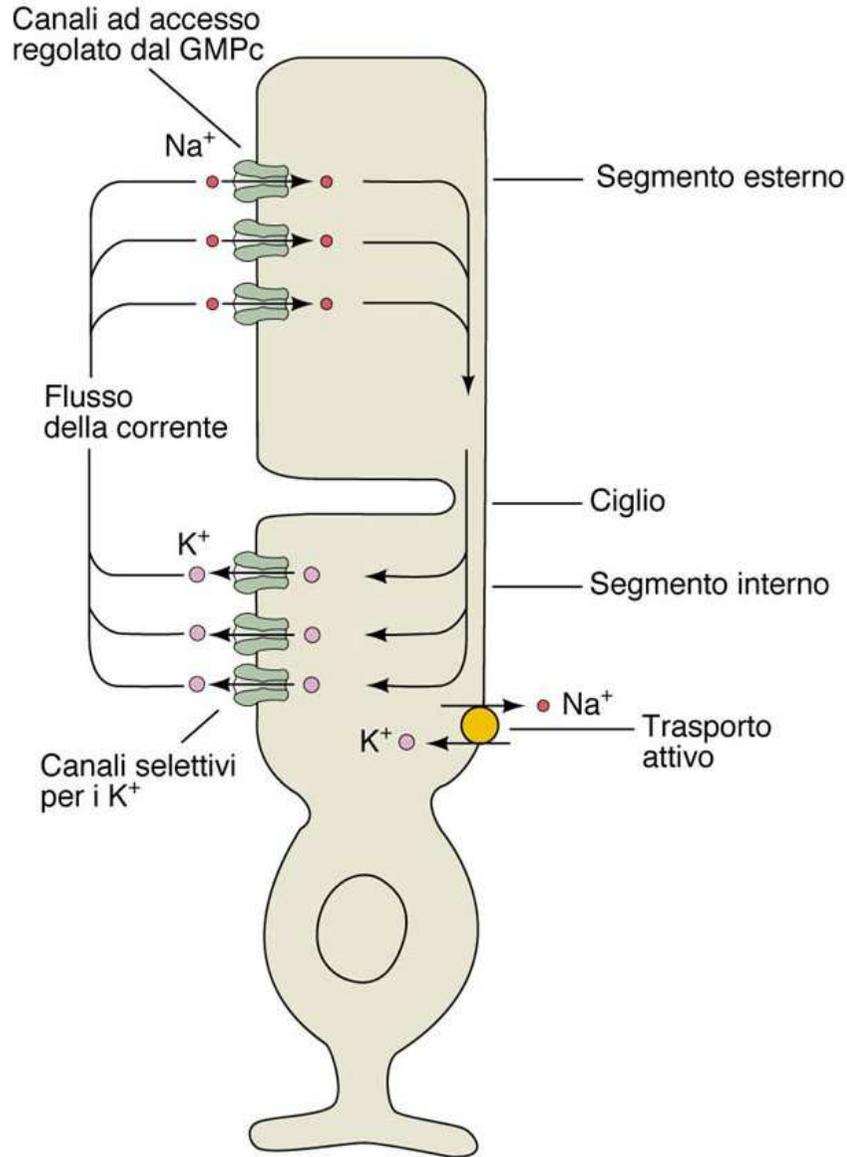




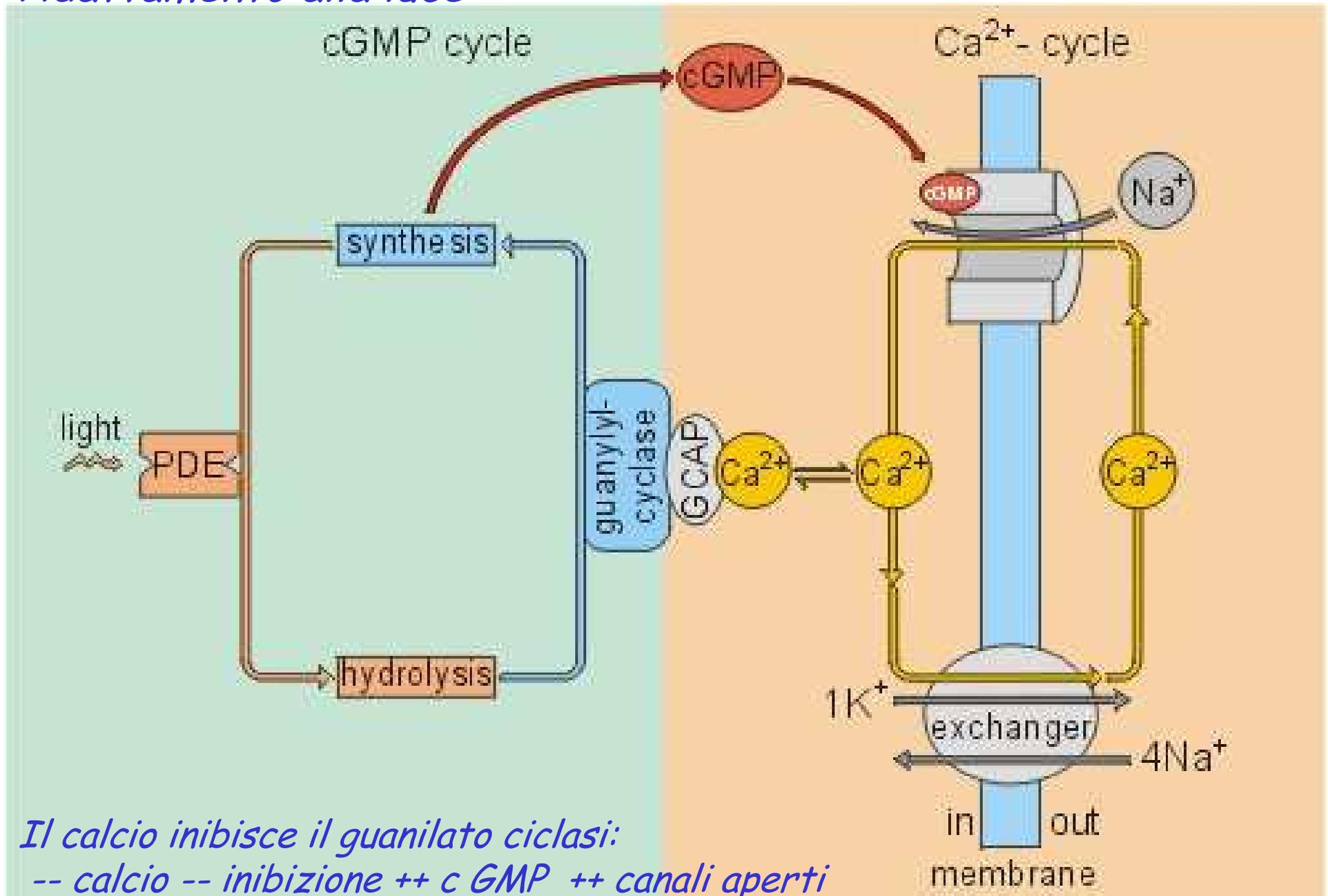
# Trasduzione



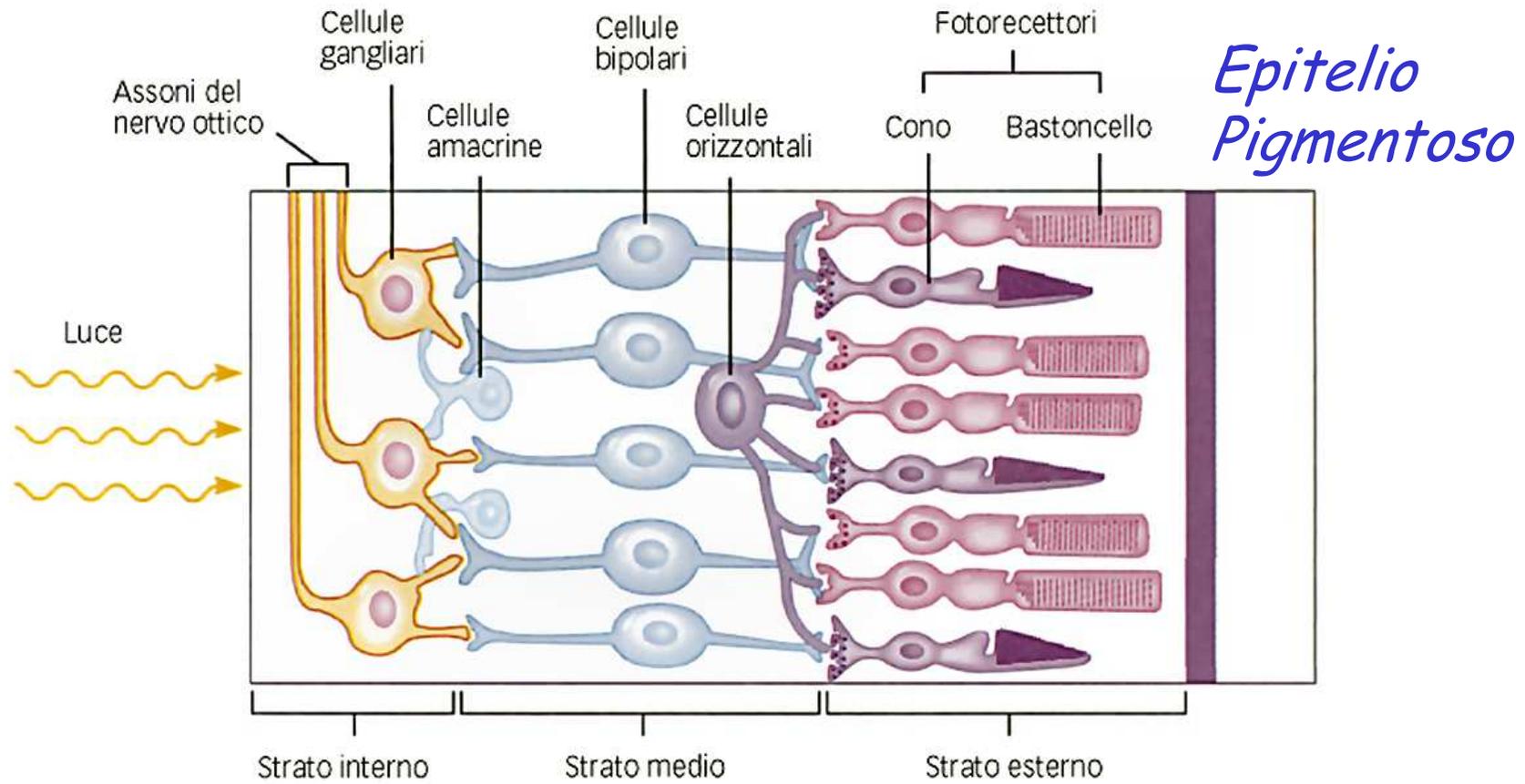
# Corrente al buio bloccata dalla luce



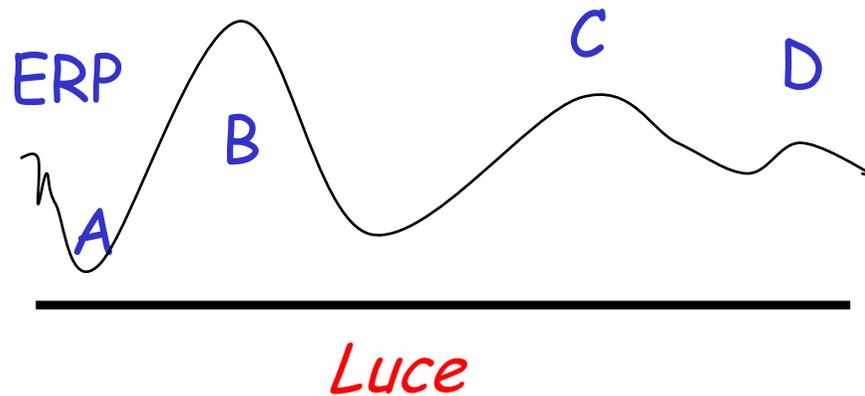
## Adattamento alla luce



*Il calcio inibisce il guanilato ciclastasi:  
-- calcio -- inibizione ++ c GMP ++ canali aperti*



# *Elettroretinogramma*



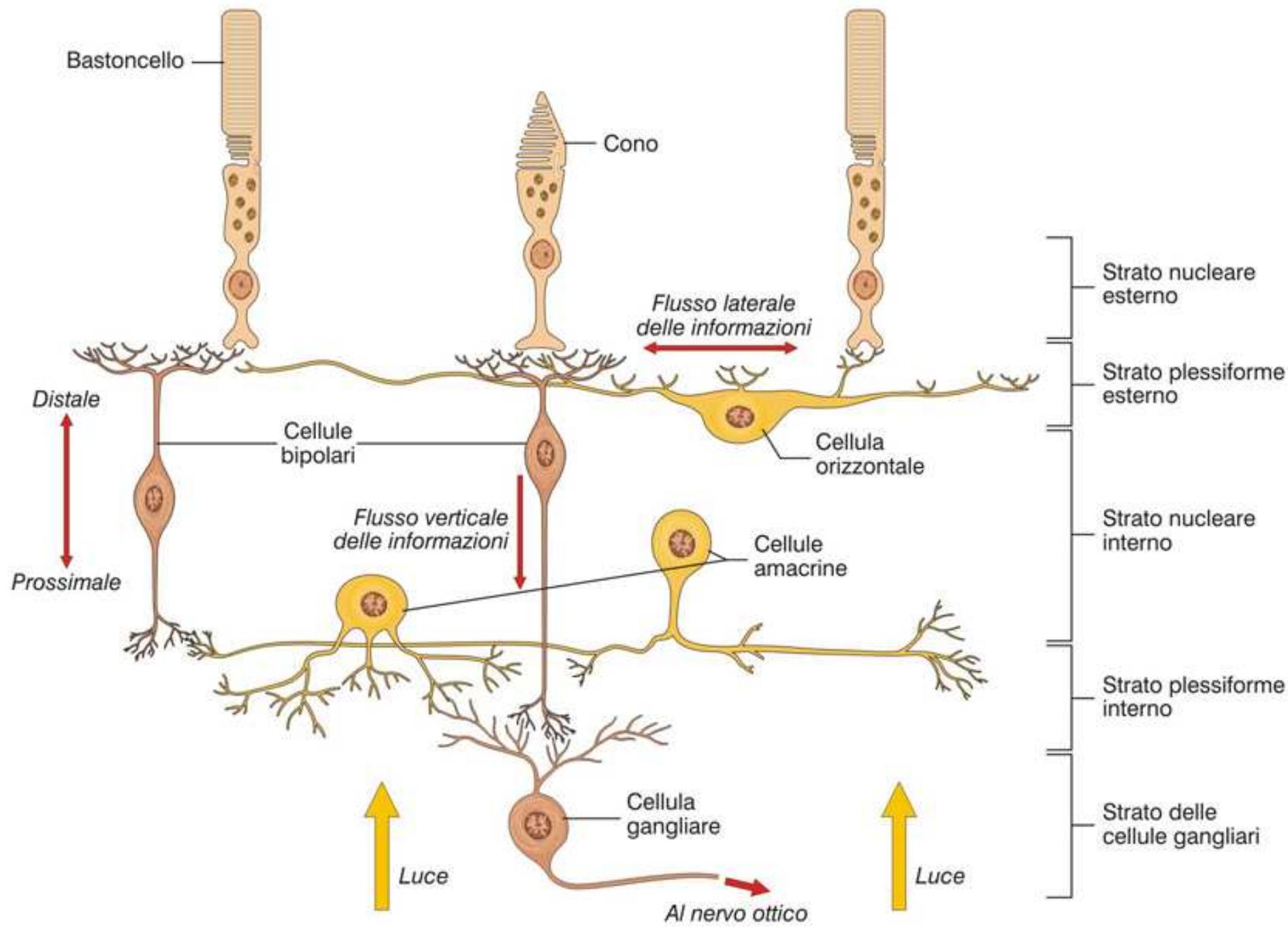
ERP: modificazioni chimiche

A: recettori

B: Muller (K)

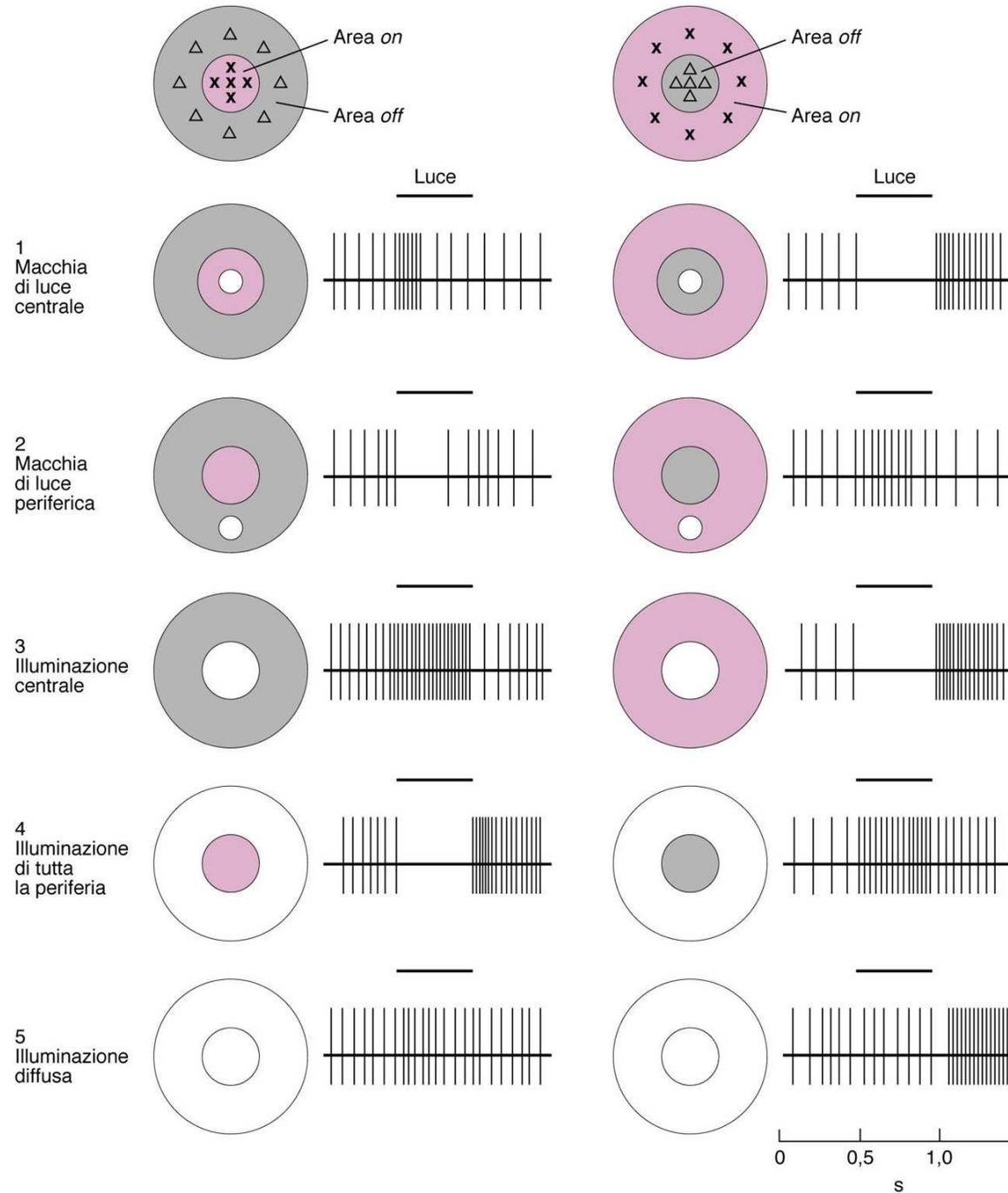
C: Epitelio pigmentato (K)

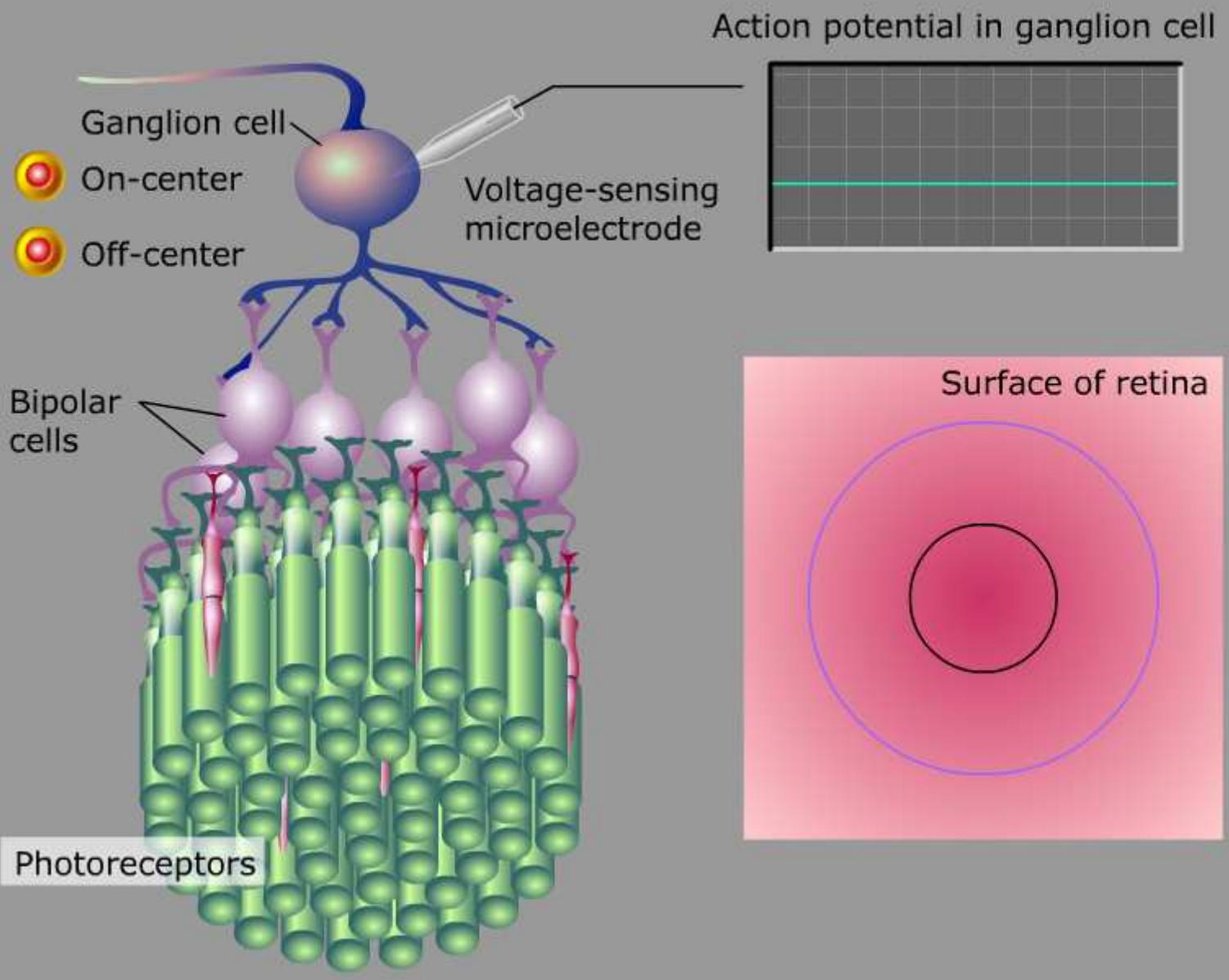
D: OFF

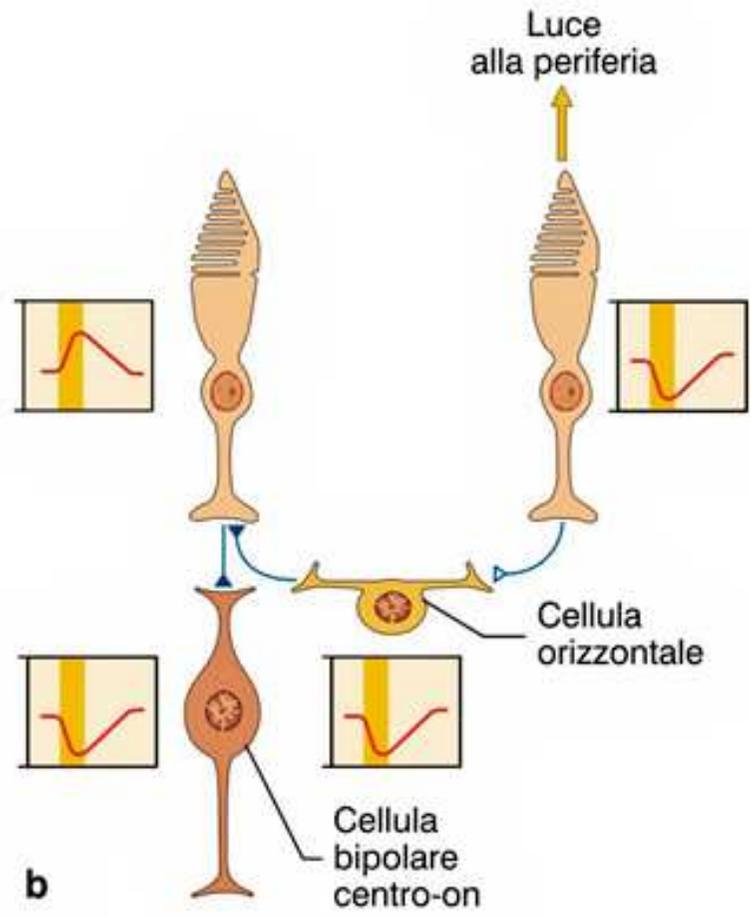
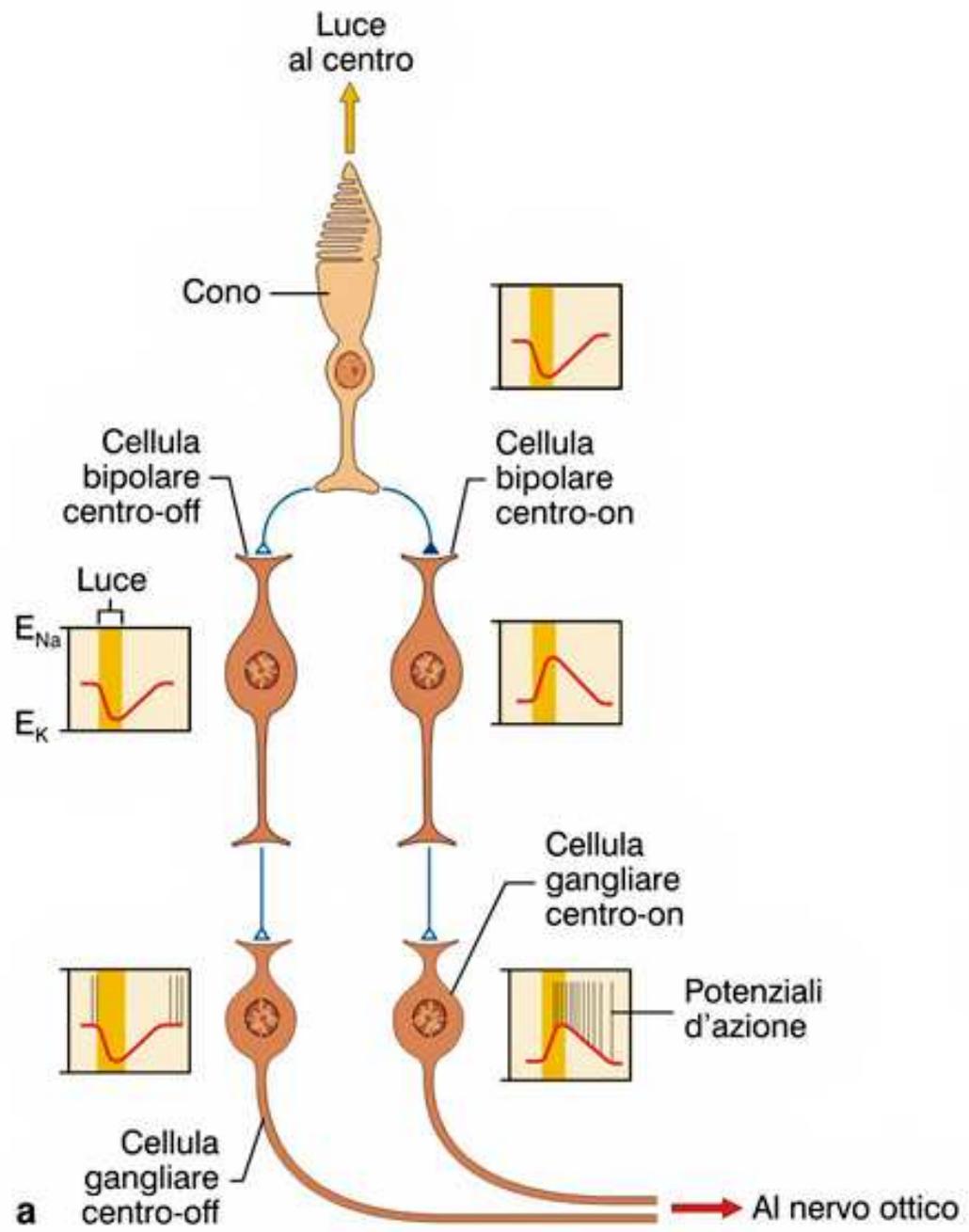


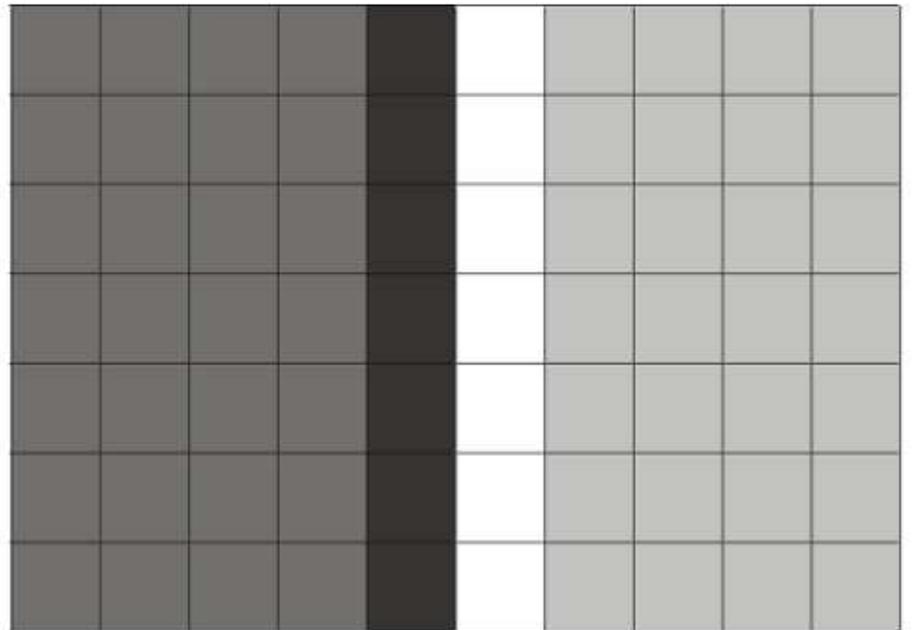
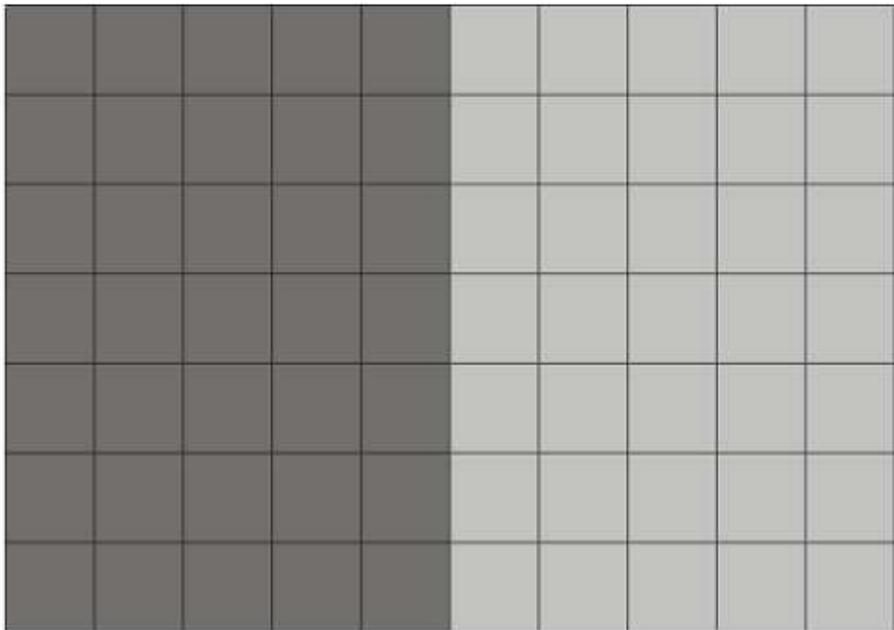
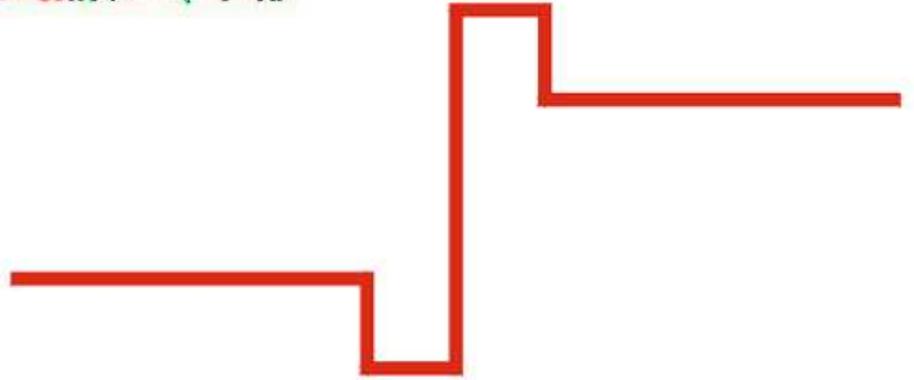
**A** Cellule gangliari centro-on

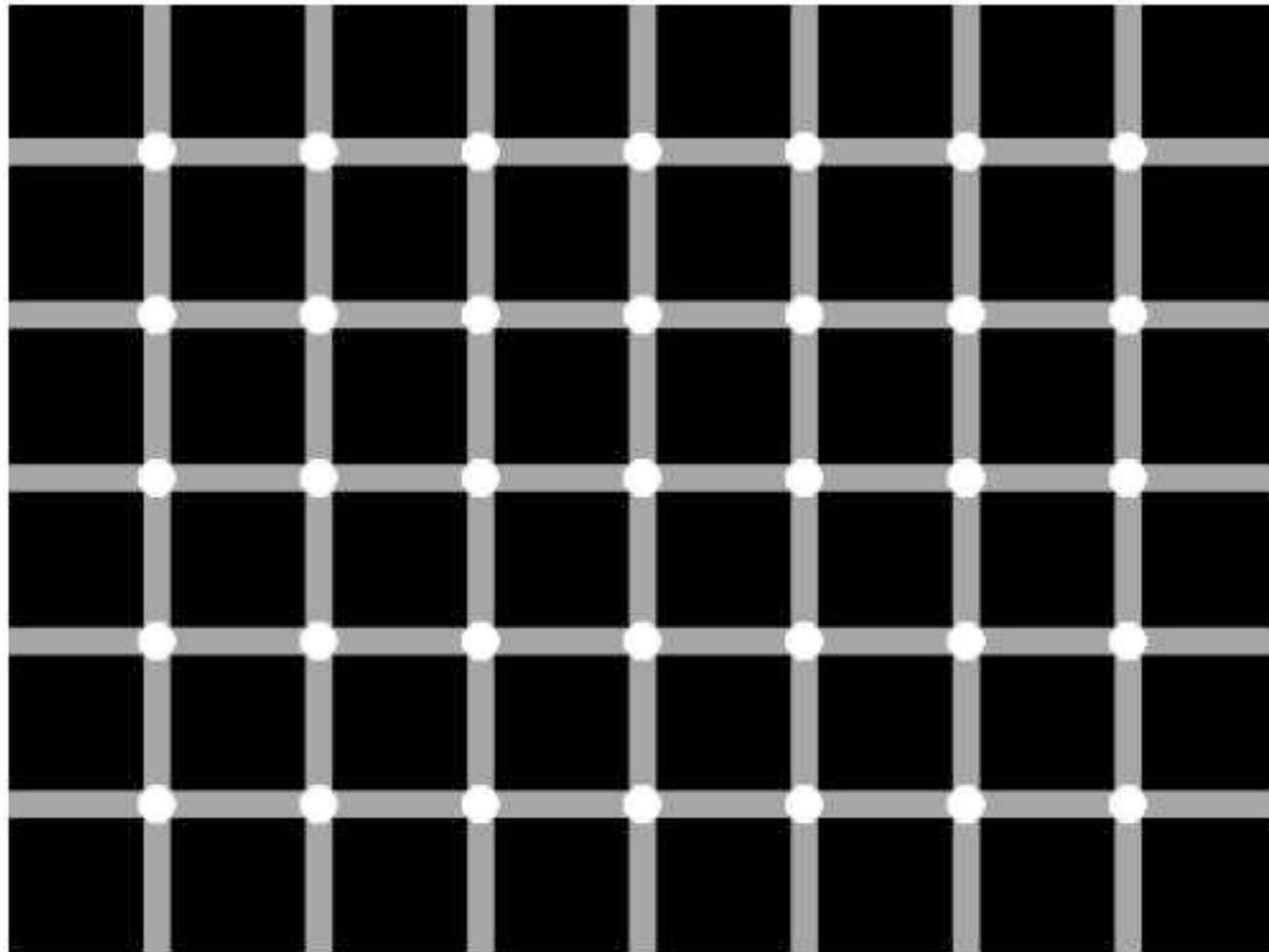
**B** Cellule gangliari centro-off





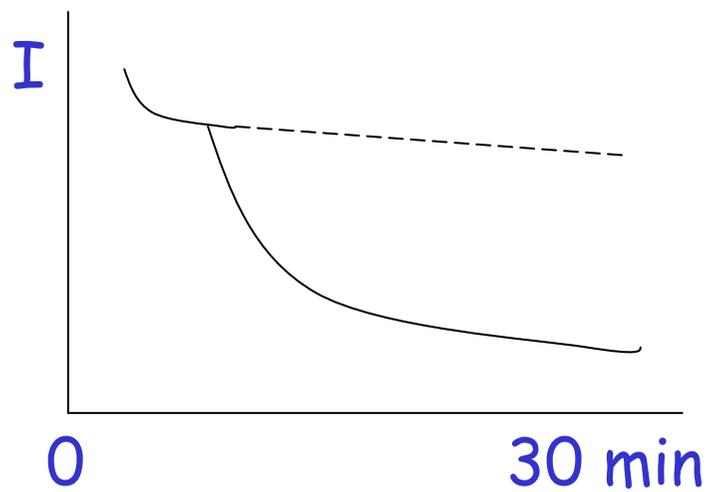




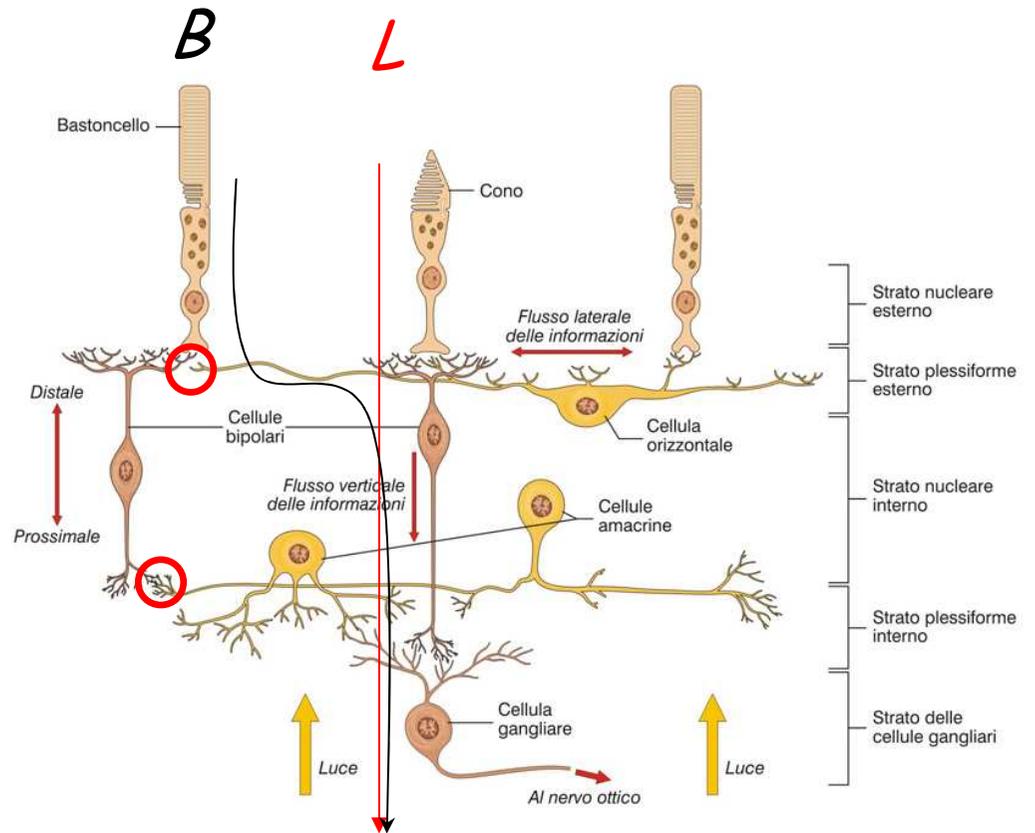


Conta i punti neri :o)

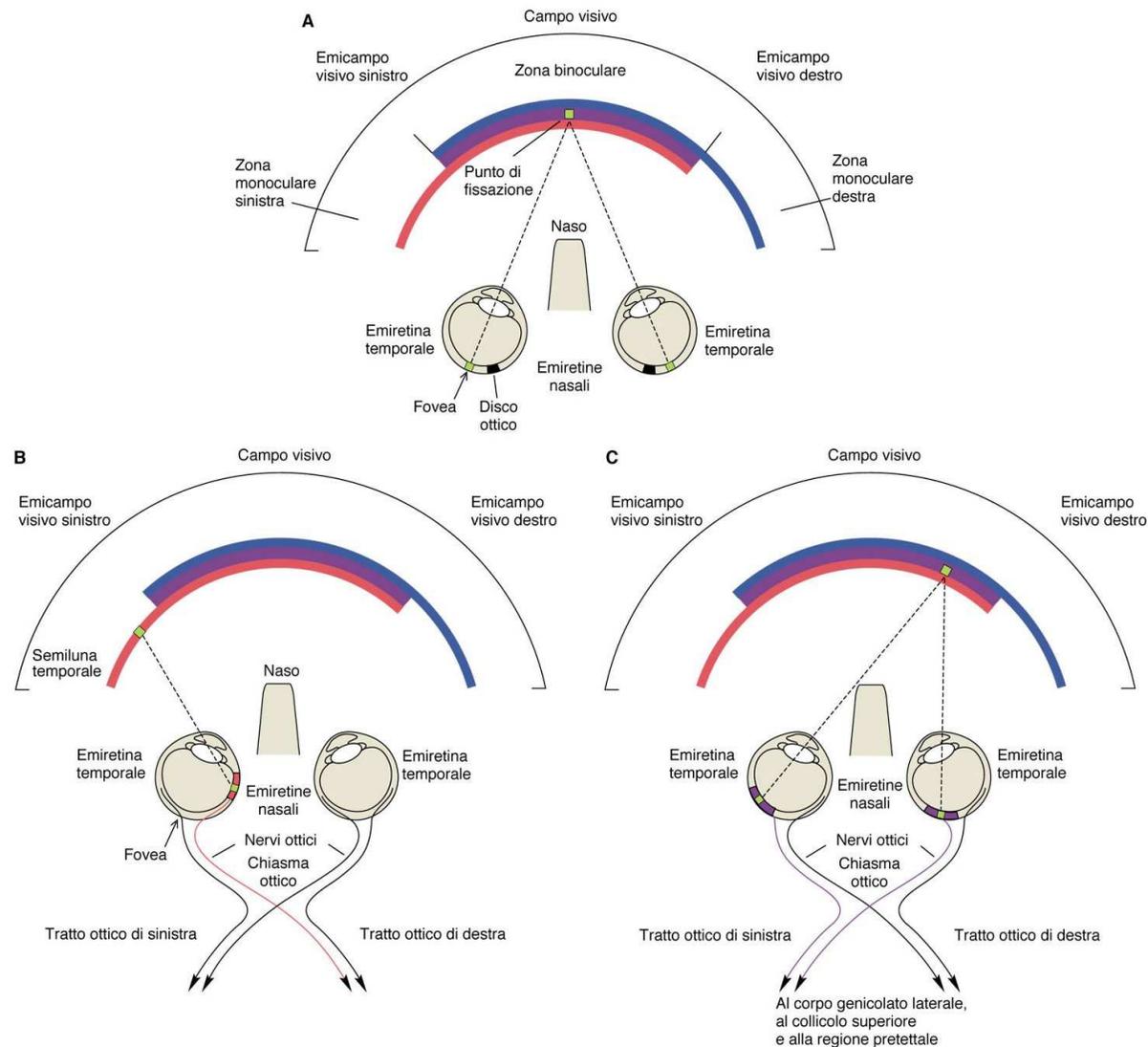
# Curva adattamento al buio

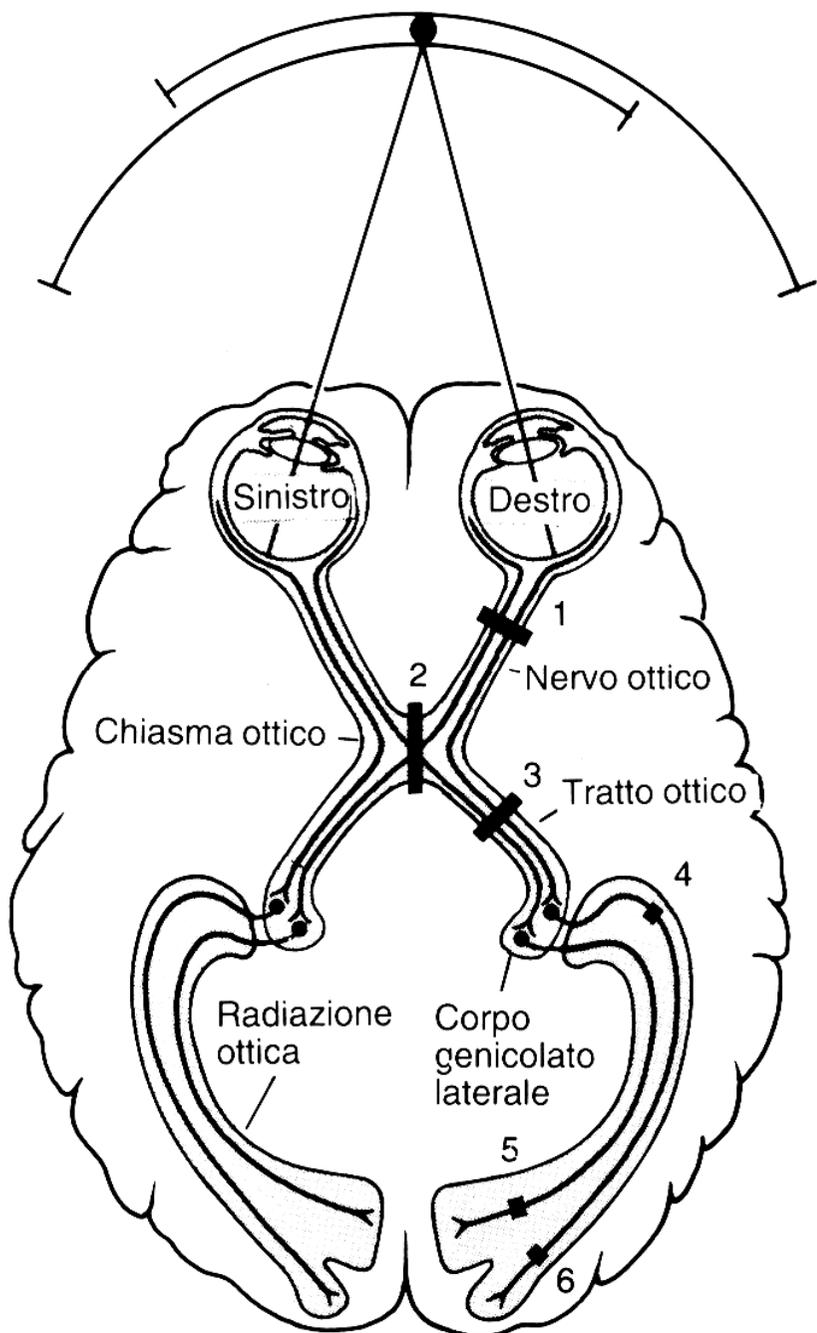


# Adattamento al buio



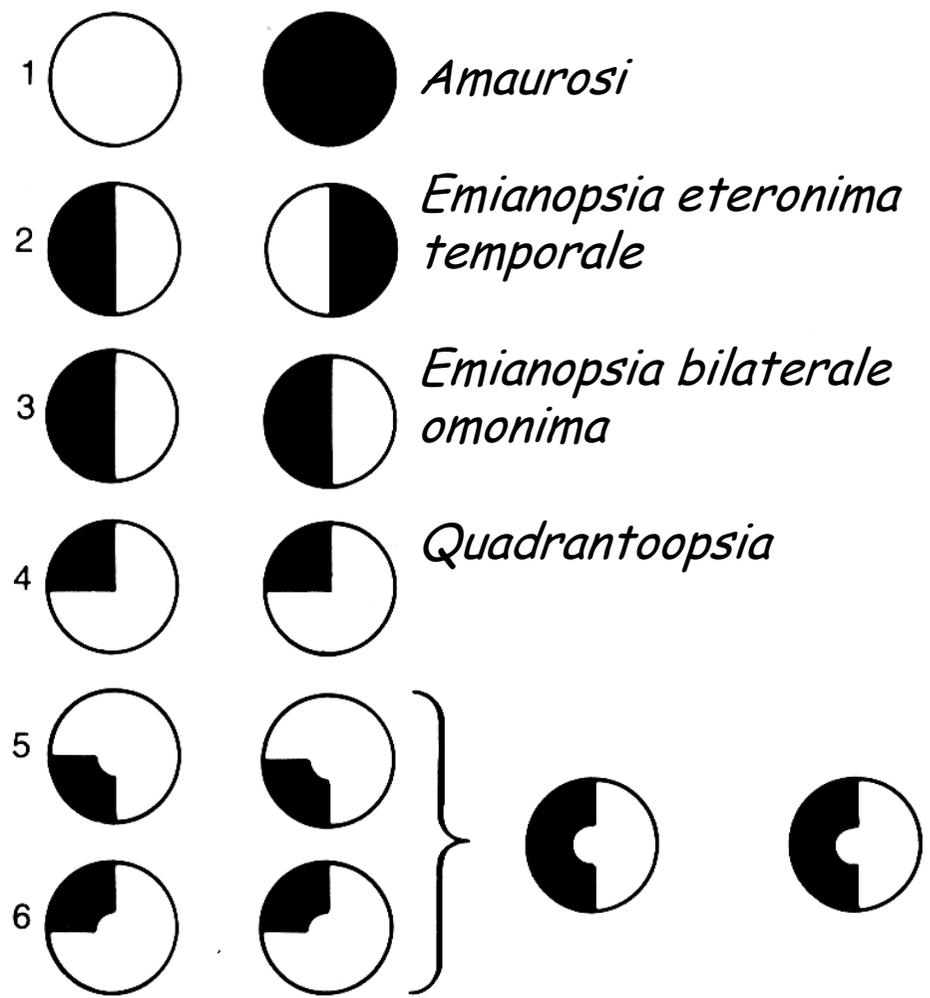
- *Acuità visiva in decimi*
- *Campo visivo: analisi per intensità colore ed ampiezza*
- *Distribuzione spaziale*

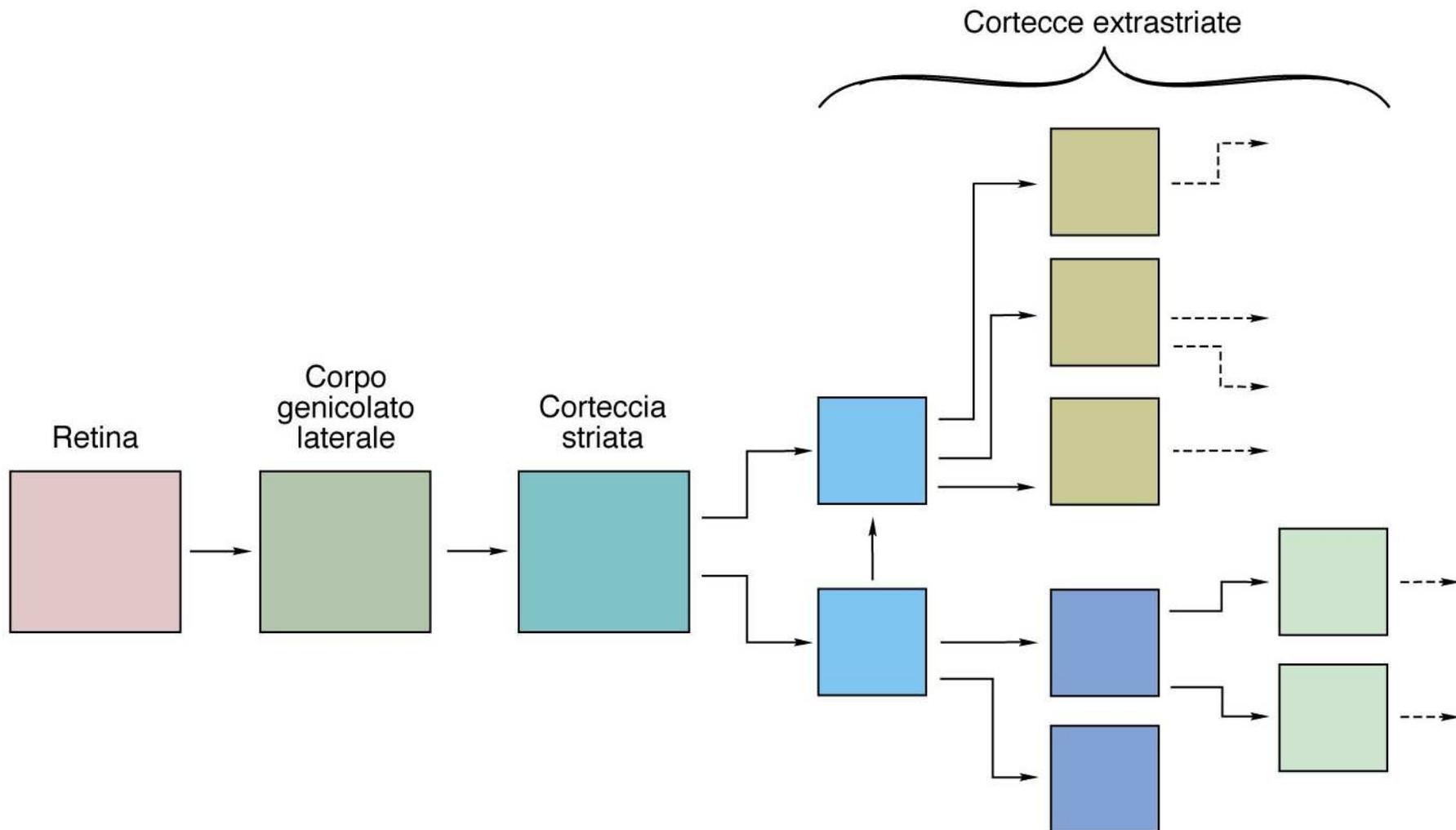


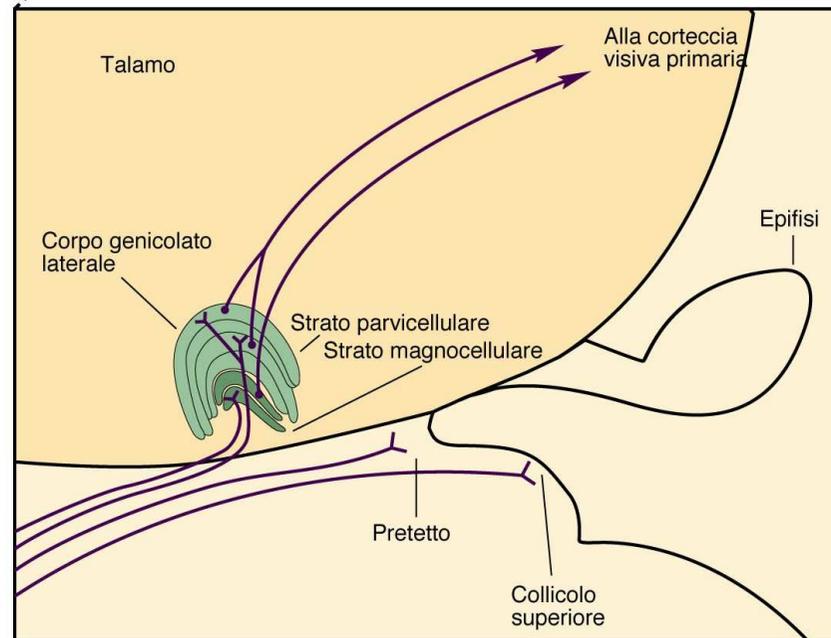
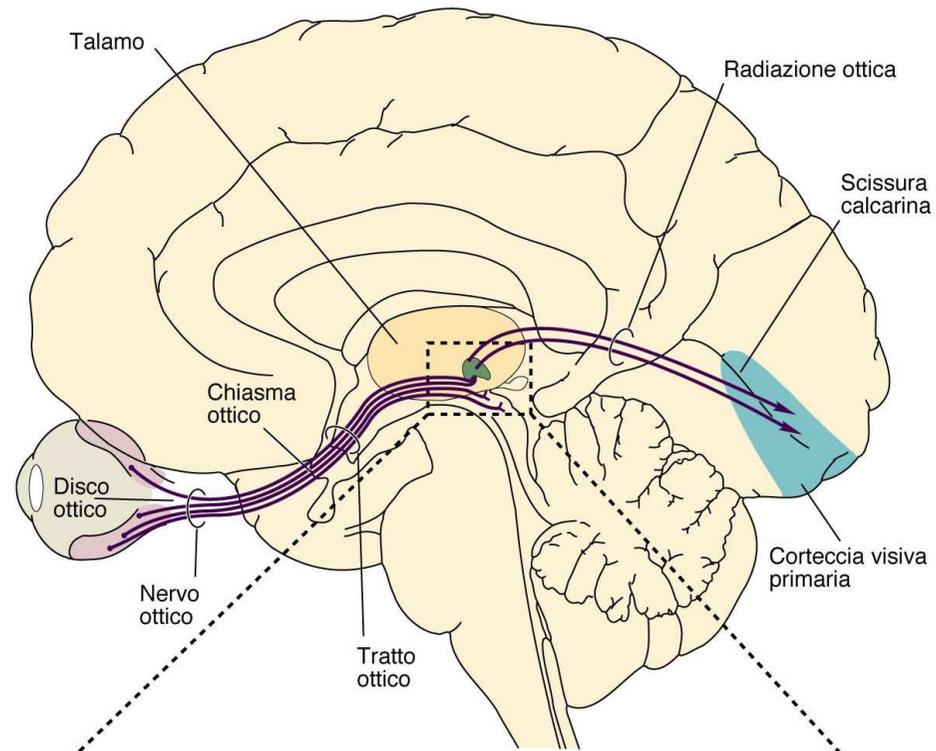


Alterazione  
del campo visivo

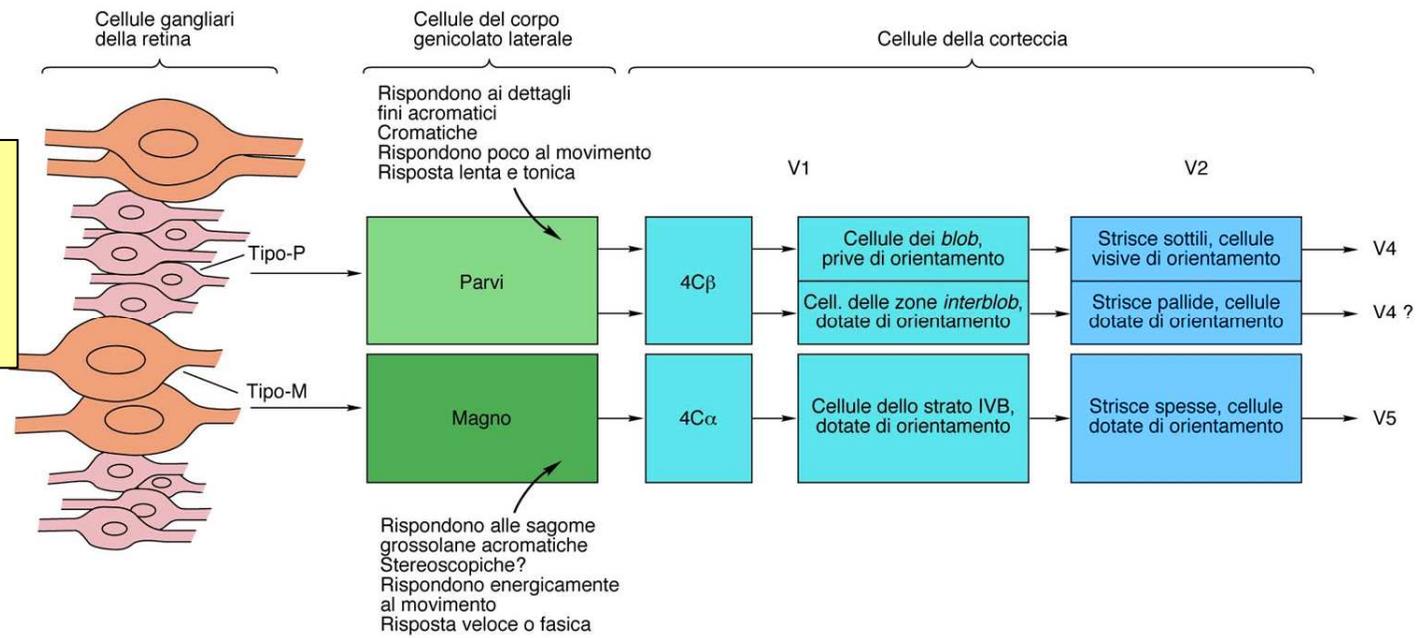
Occhio sinistro    Occhio destro

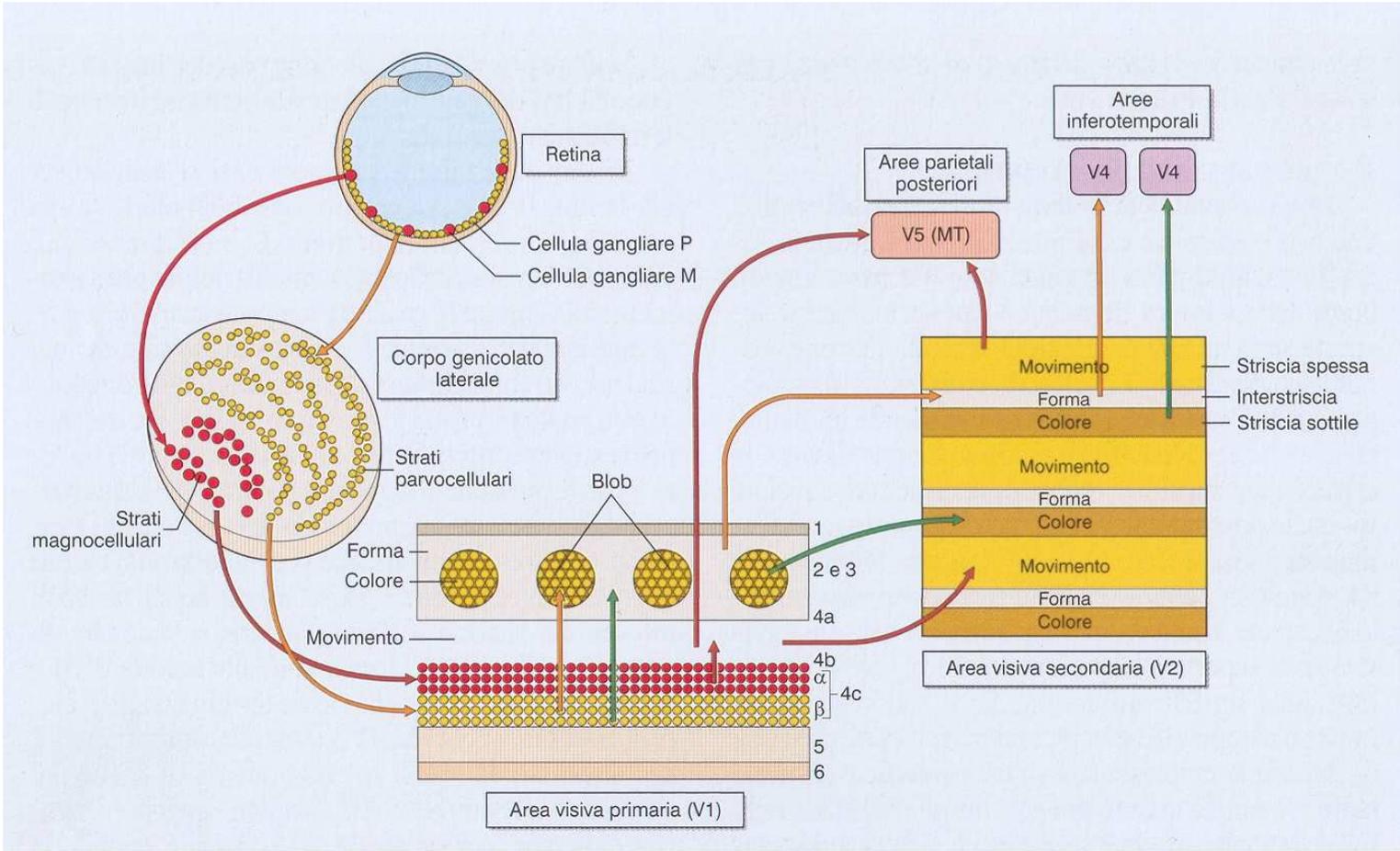


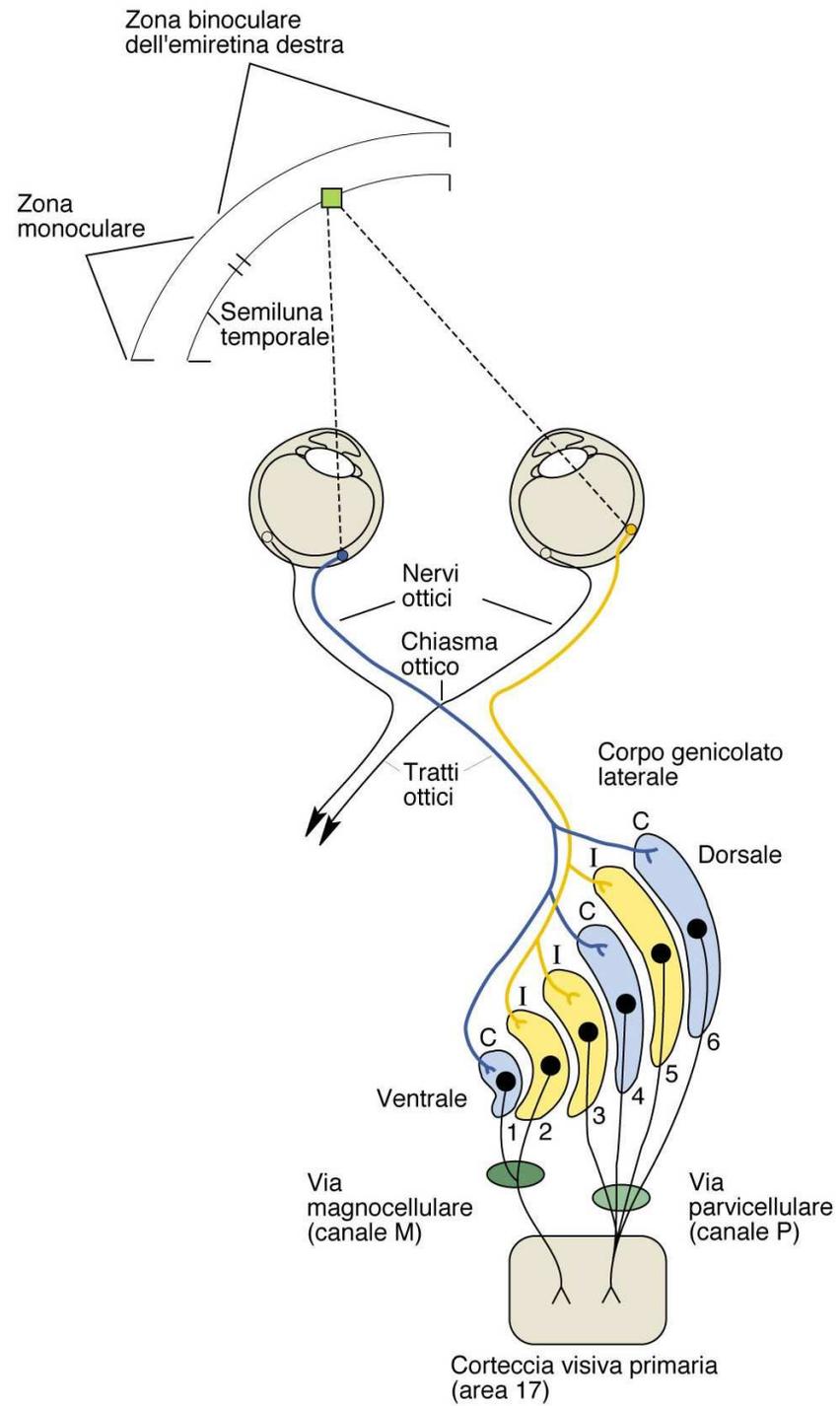




Nervo ottico  
 X = piccole  
 Y = grandi, movimento  
 W = intermedie



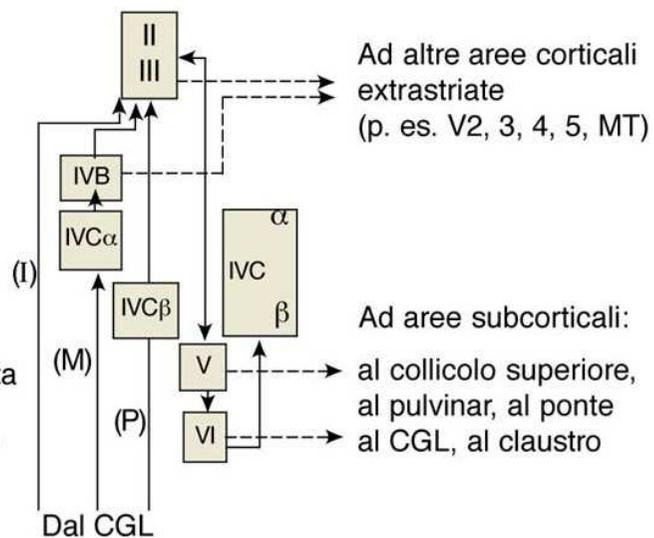
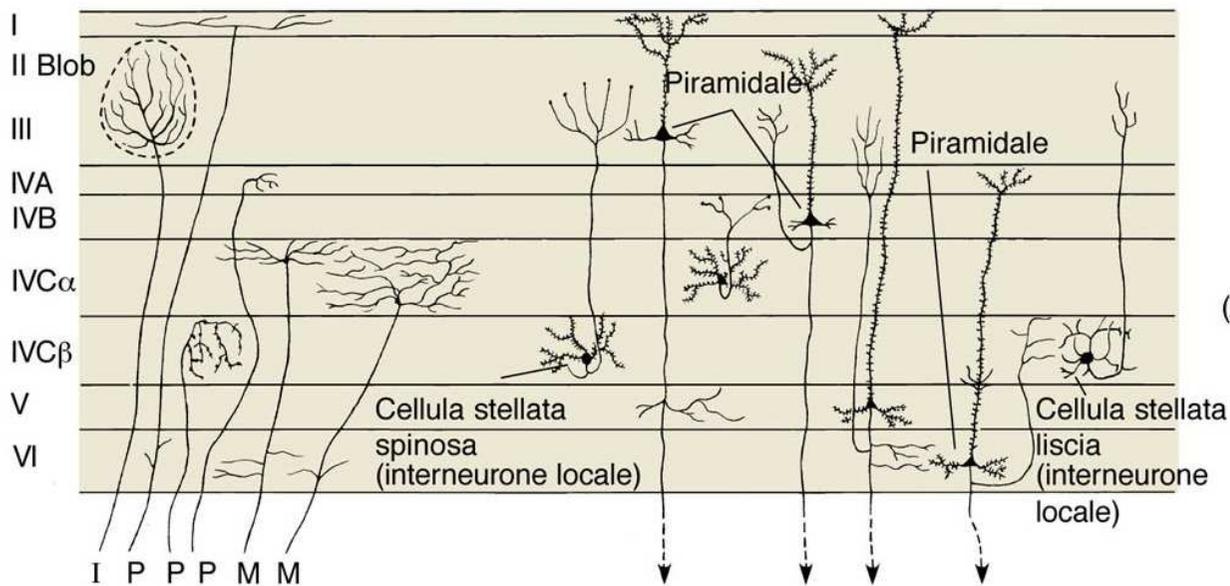


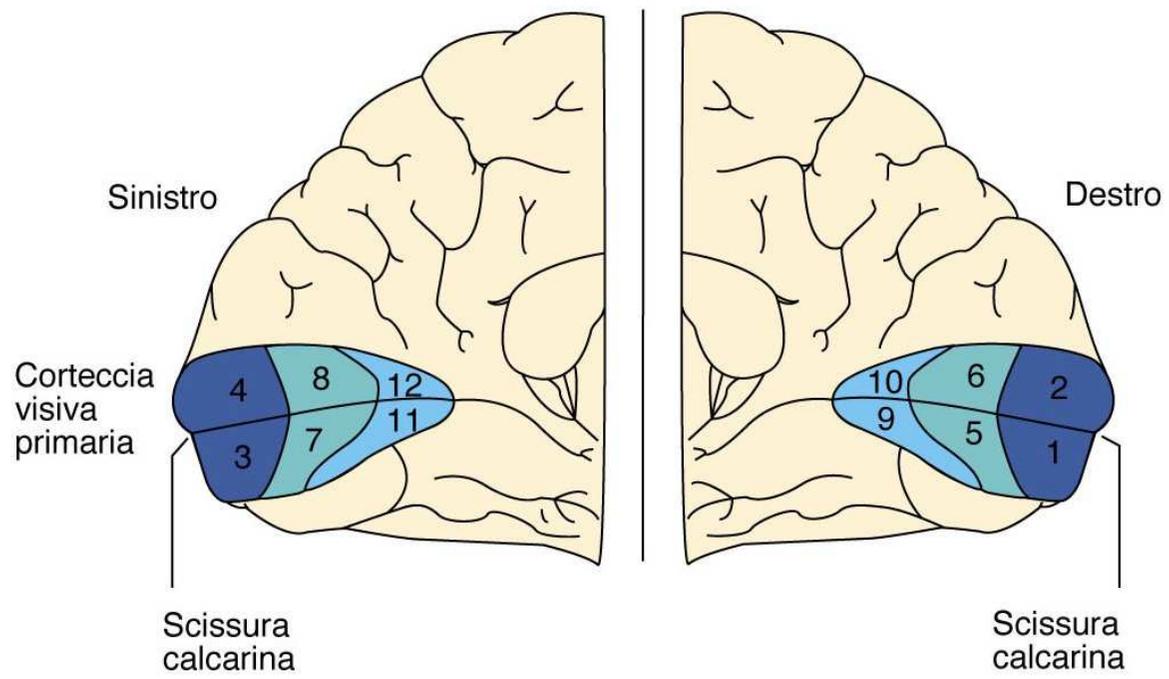
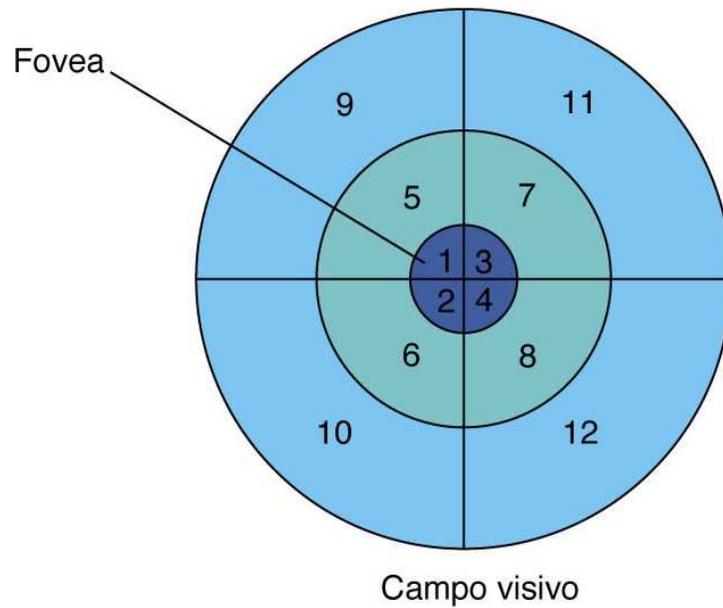


A Afferenze dal corpo genicolato laterale

B Cellule presenti nei diversi strati

C Flusso locale delle informazioni ed efferenze

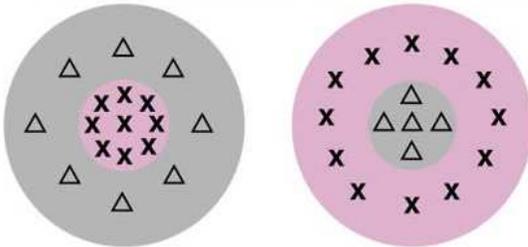




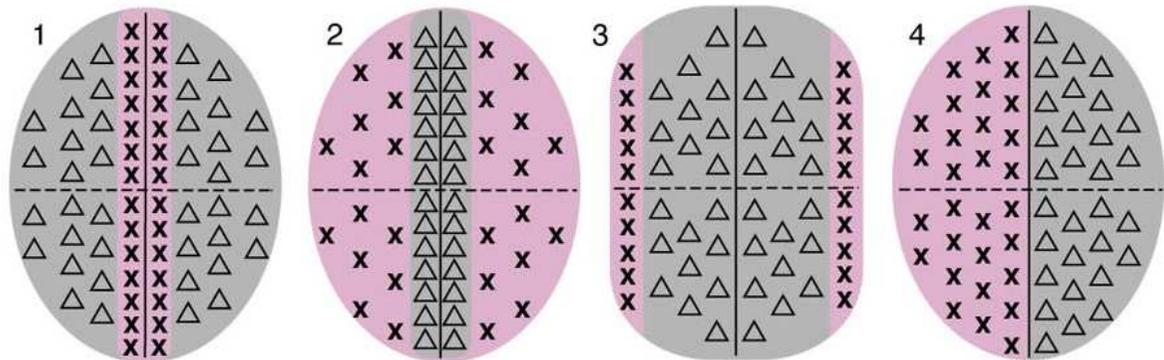
# Cellule semplici

**A** Campi recettivi concentrici delle cellule della retina, del corpo genicolato laterale e delle cellule stellate del quarto strato della corteccia

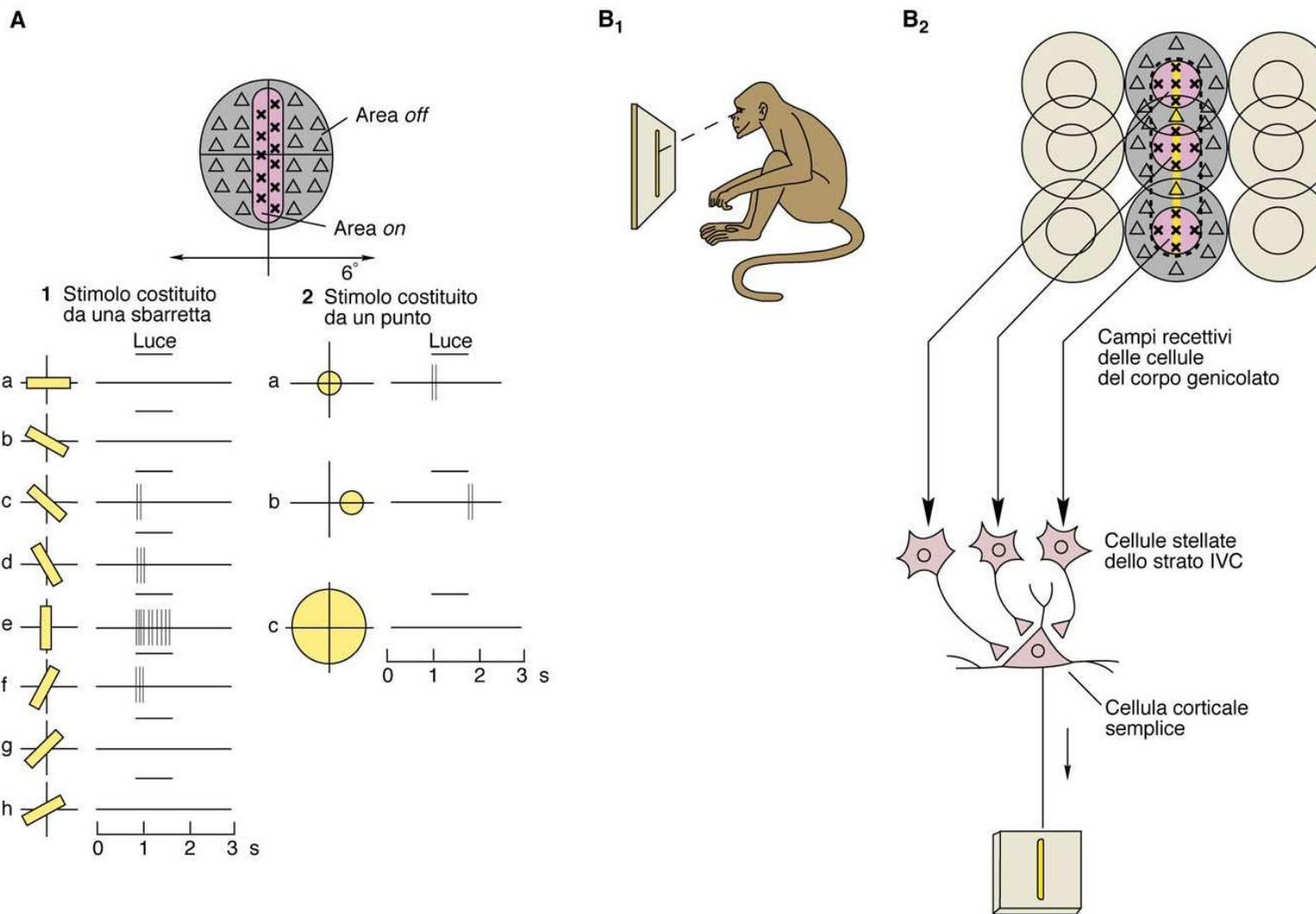
1 Cellula centro-on    2 Cellula centro-off



**B** Cellule corticali semplici

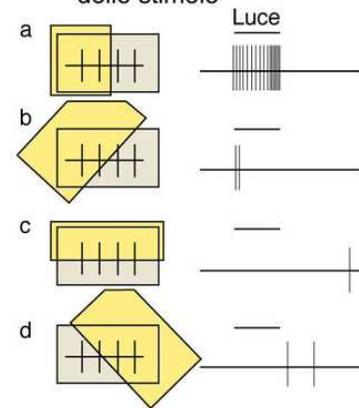


# Orientamento: cellule semplici

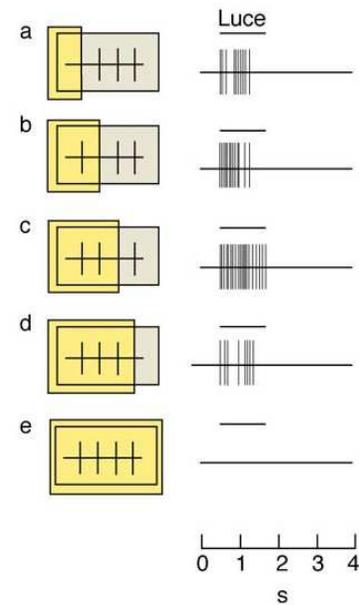


# Orientamento e indifferenza spaziale: cellule complesse

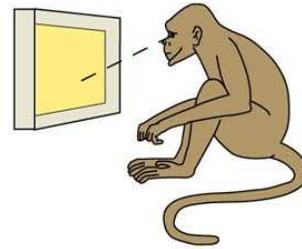
**A<sub>1</sub>** Risposte all'asse di orientamento dello stimolo



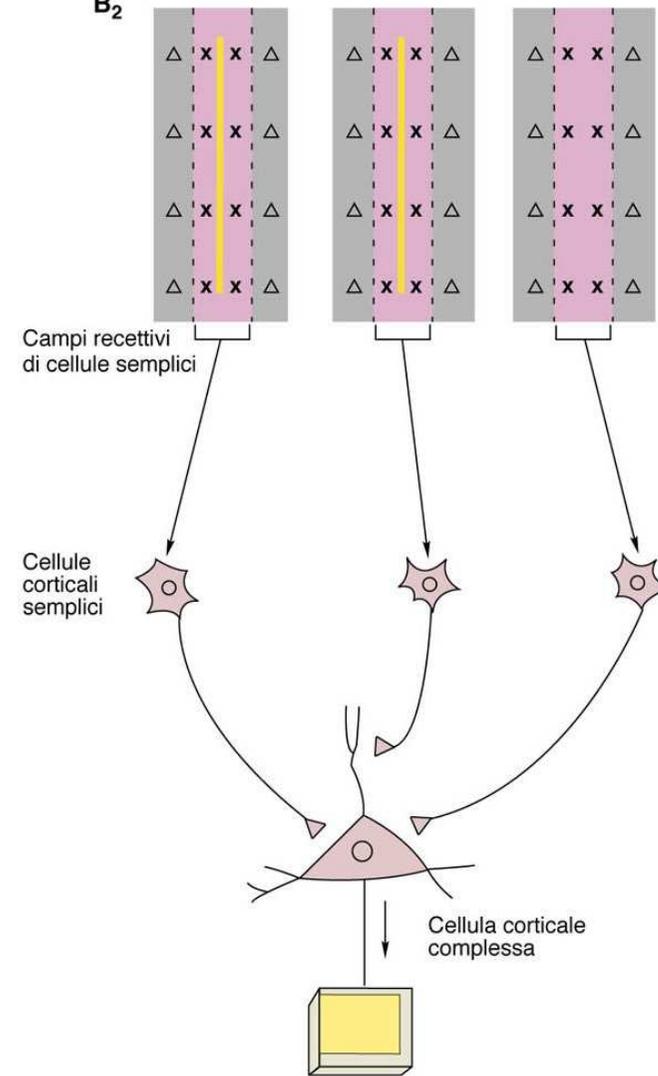
**A<sub>2</sub>** Risposte alla posizione dello stimolo



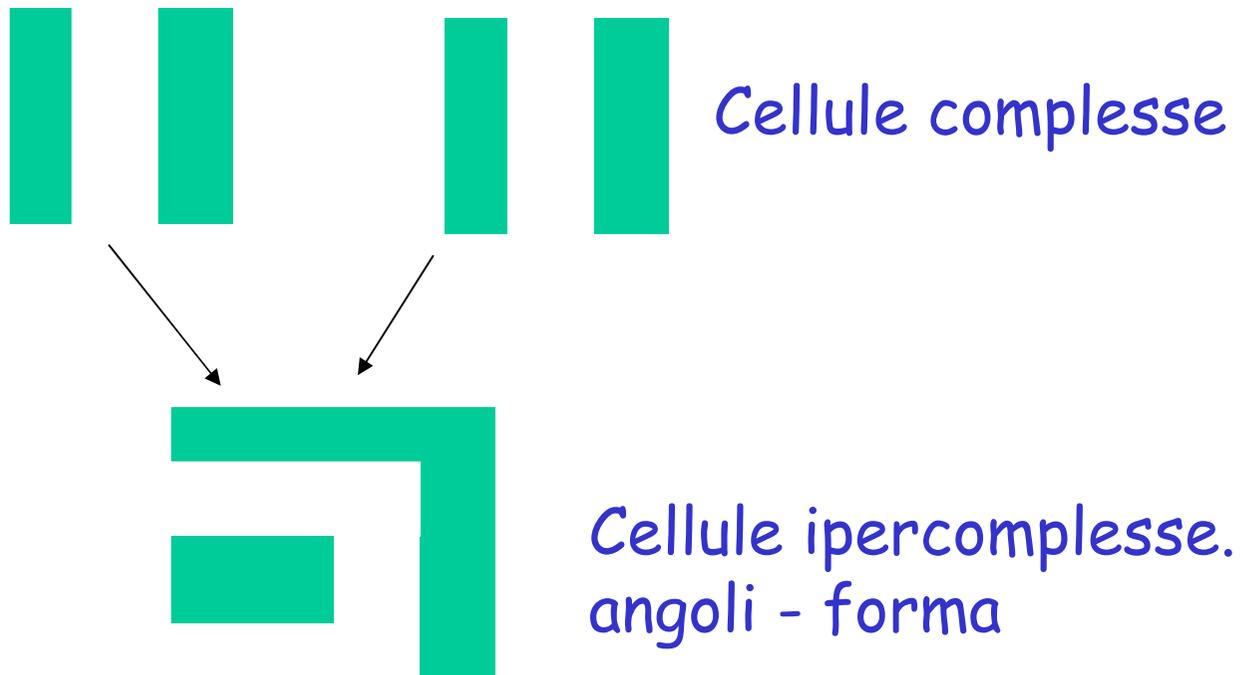
**B<sub>1</sub>**

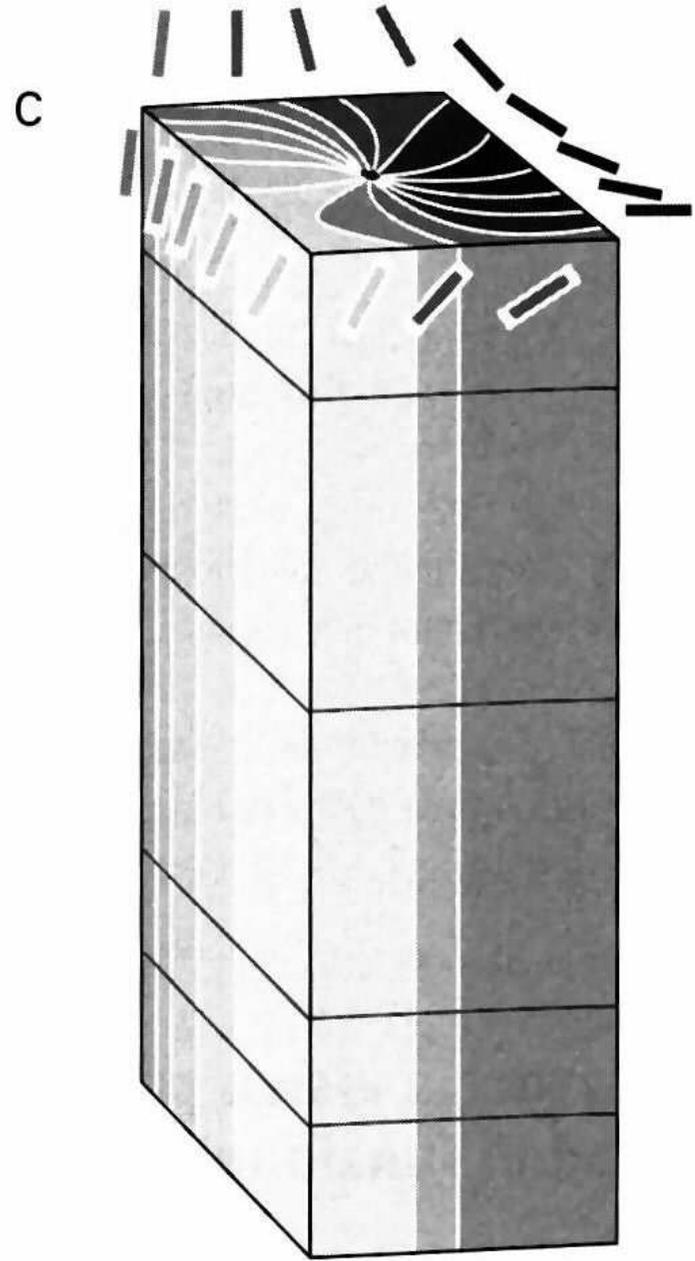
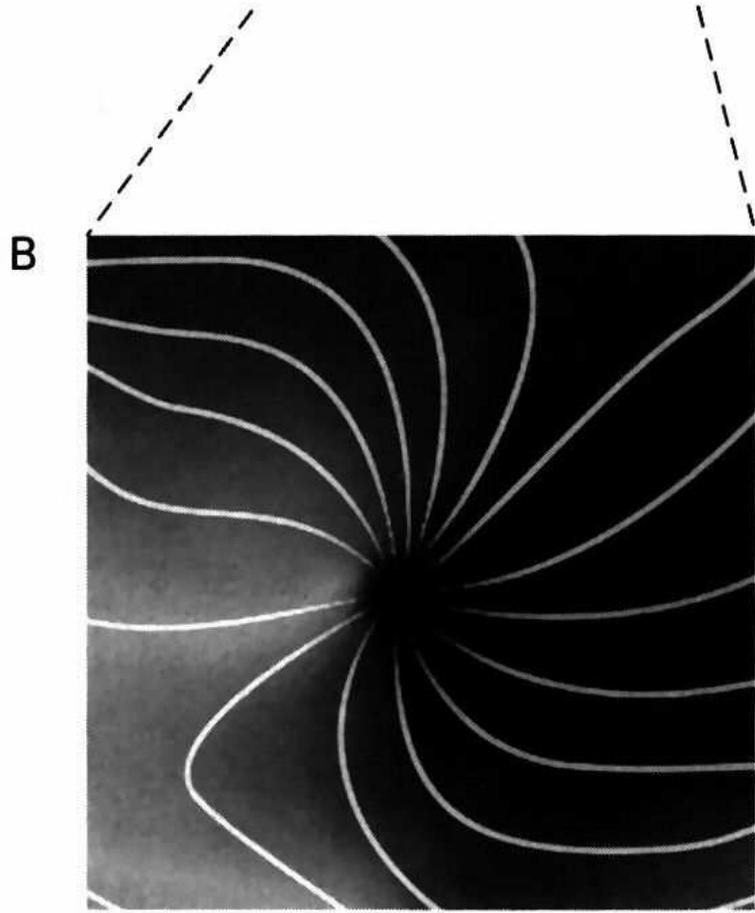


**B<sub>2</sub>**



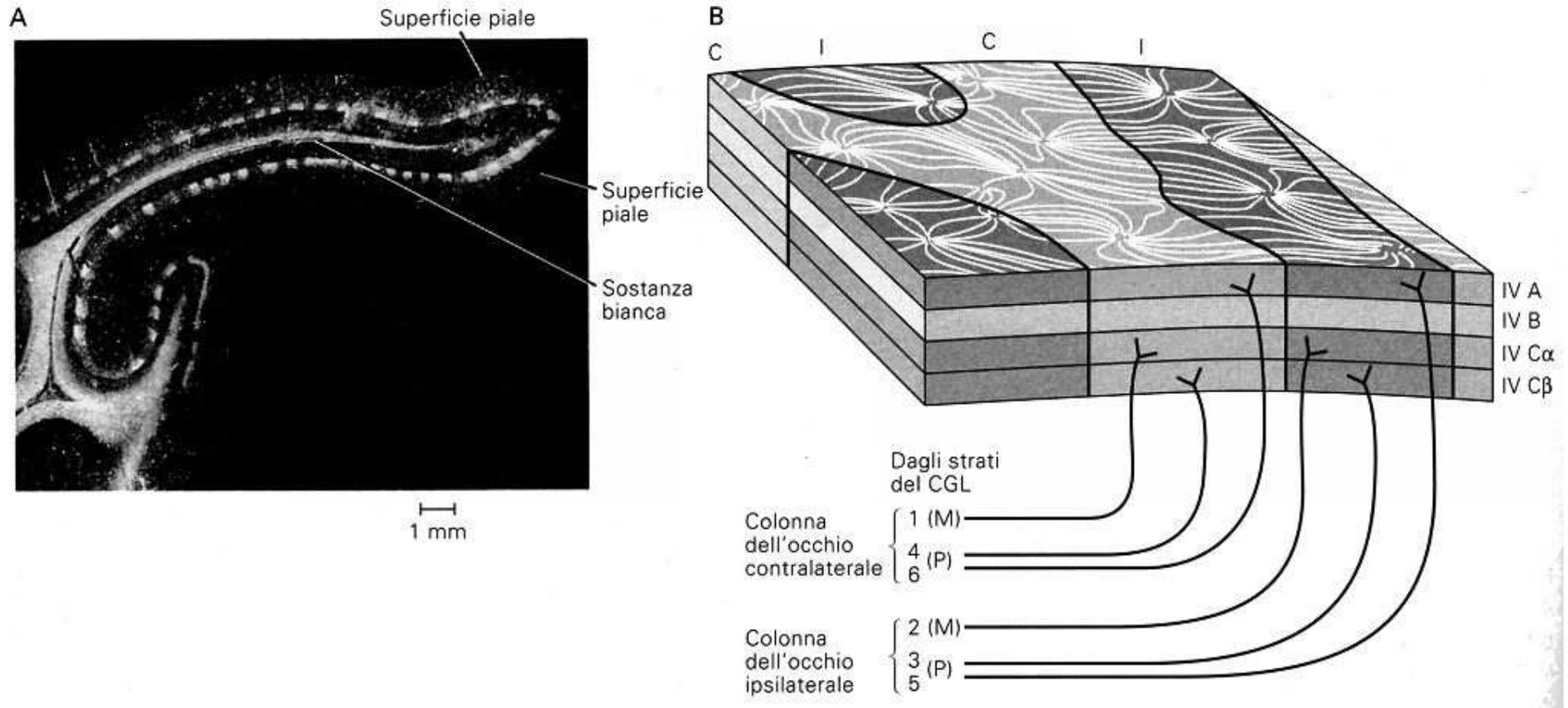
## *Cellule ipercomplesse*



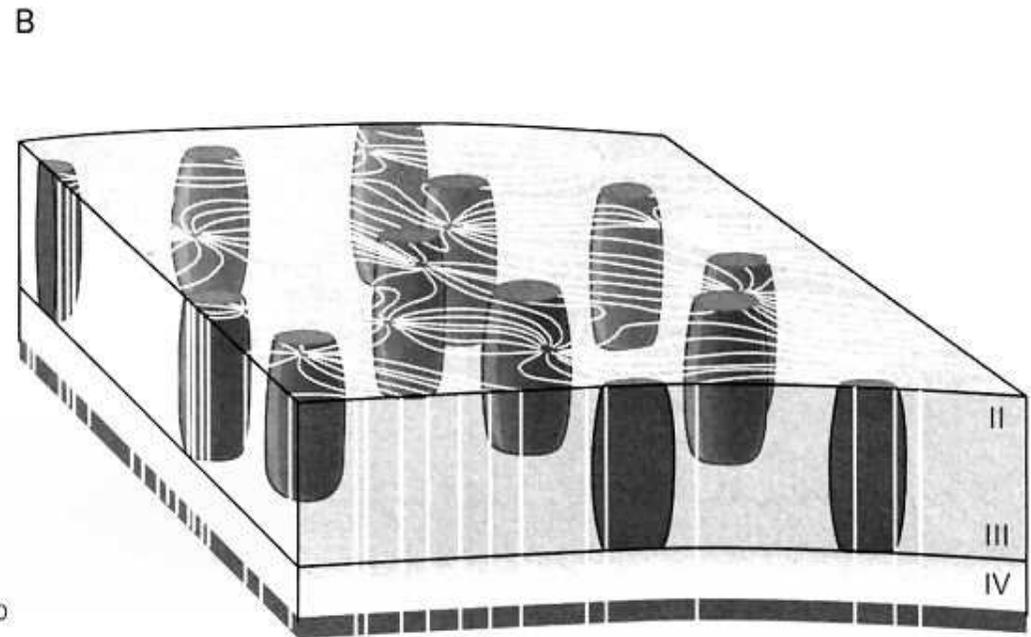
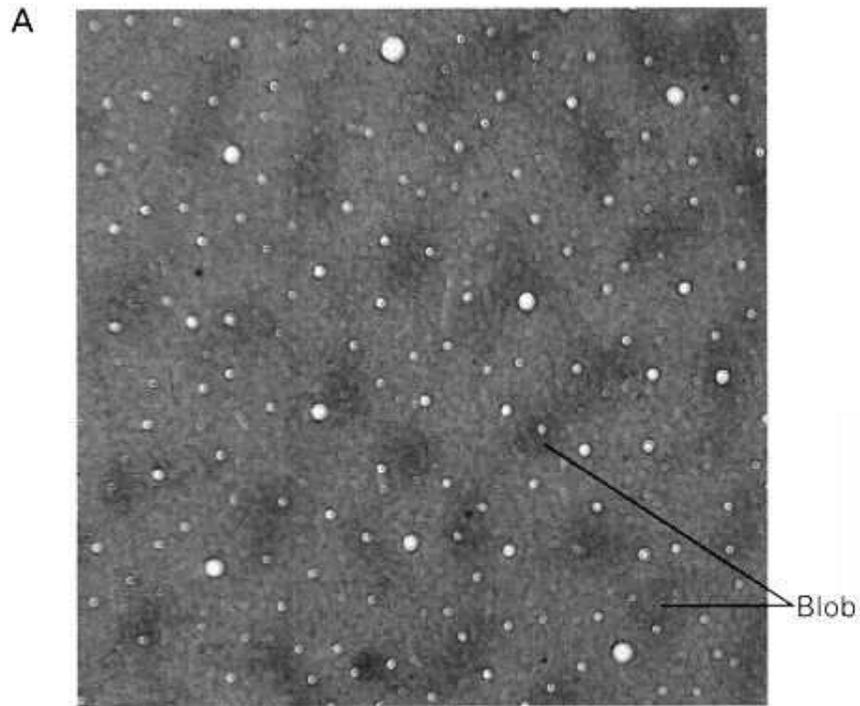


*Colonne*

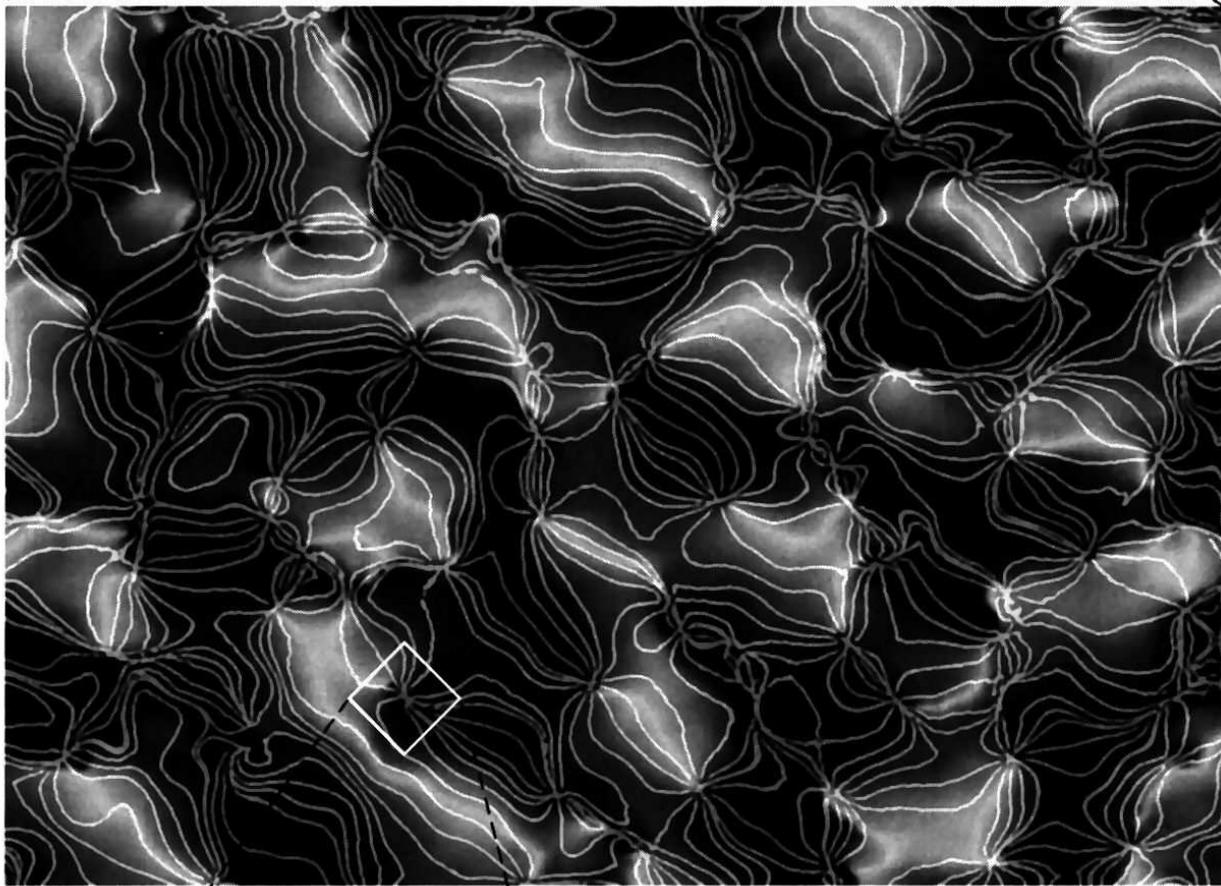
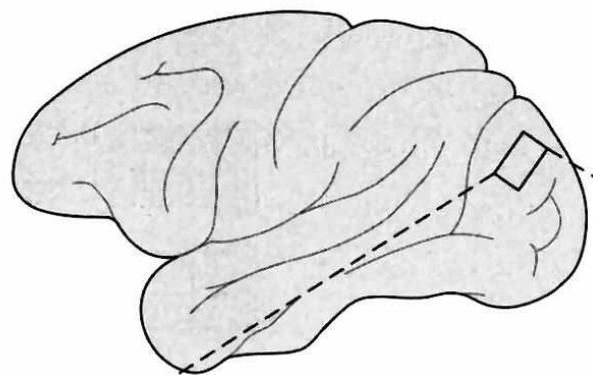
# Ipercolonna

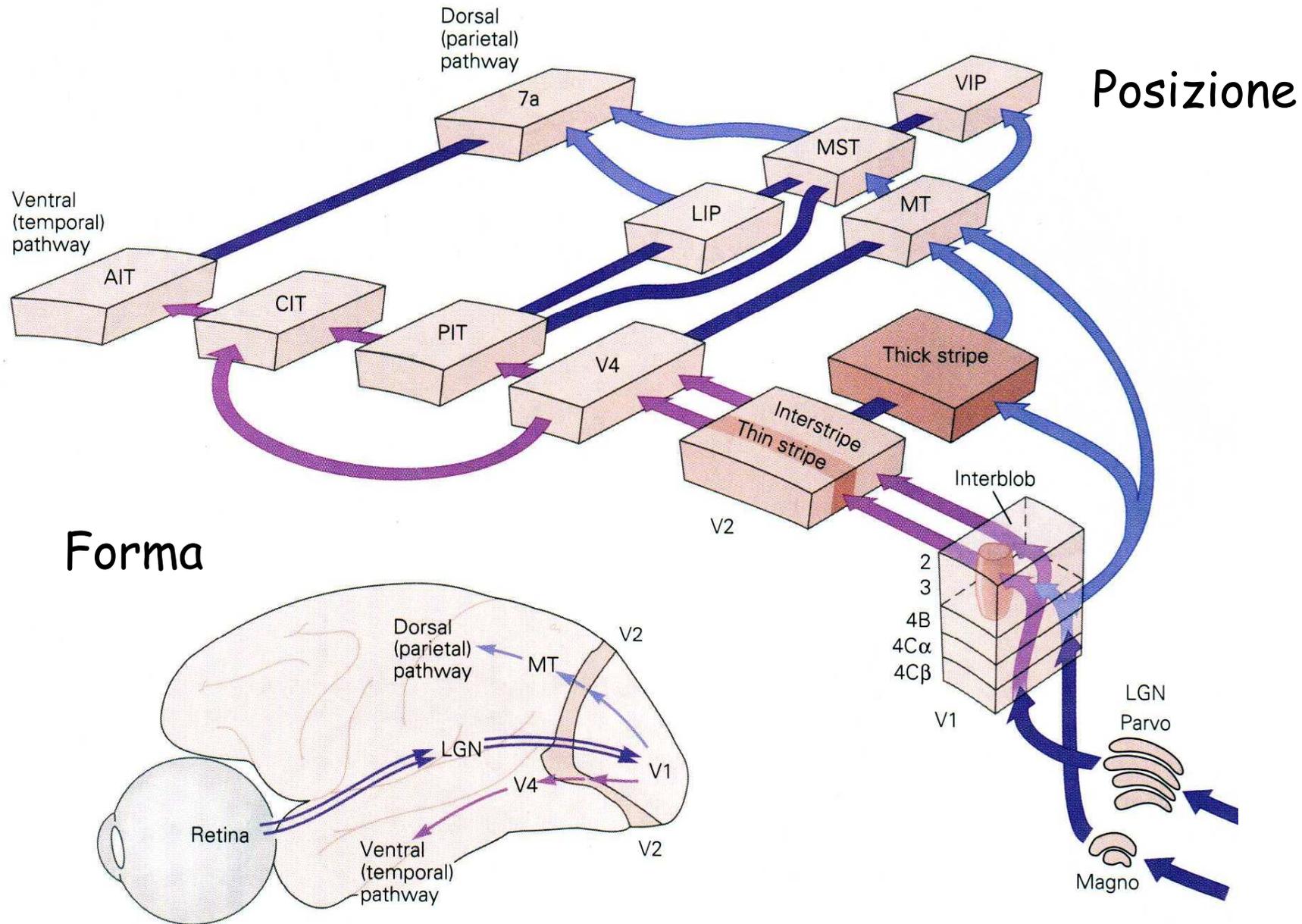


*Blob: colori*

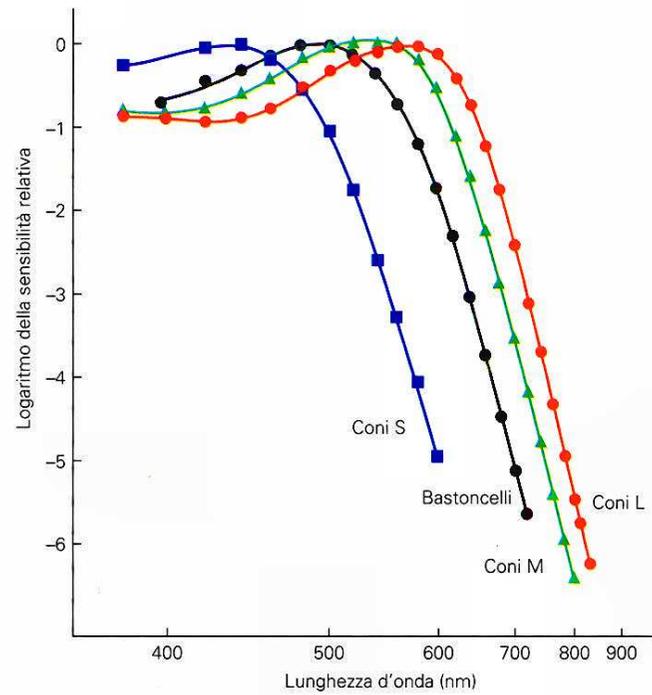


A





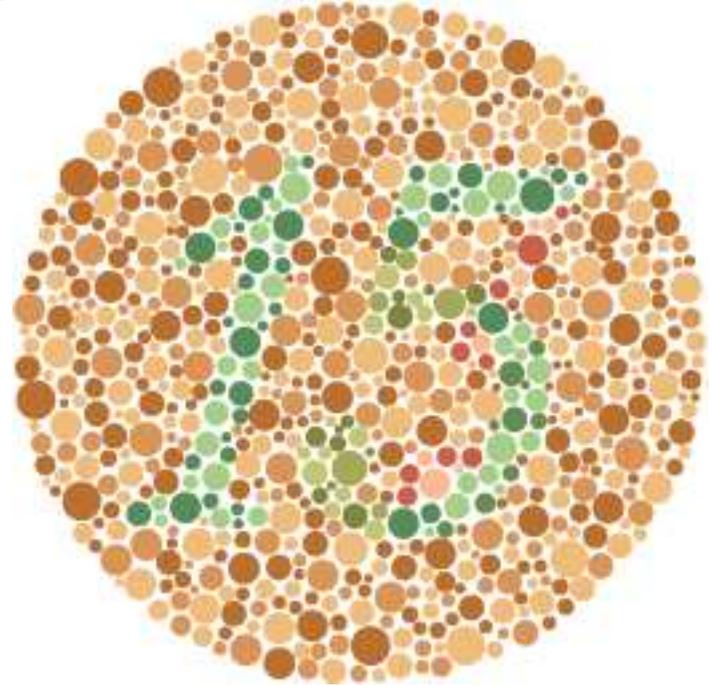
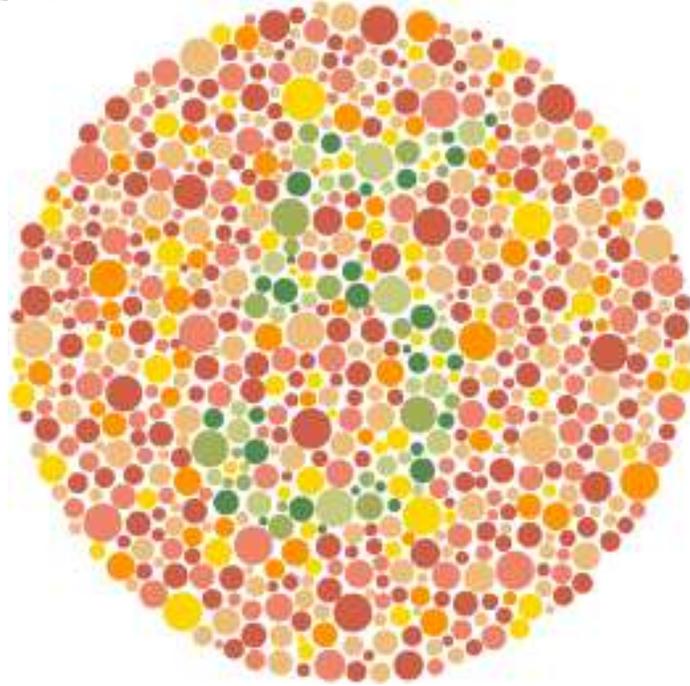
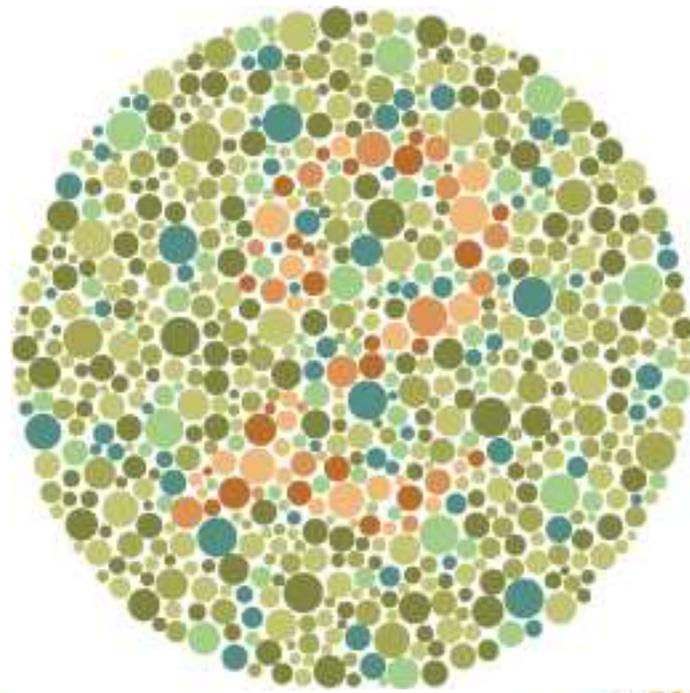
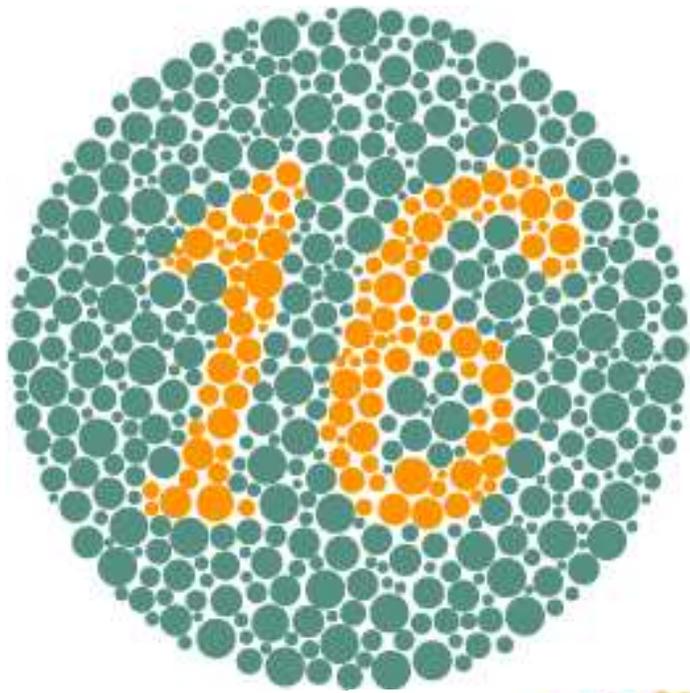
# Visione dei colori



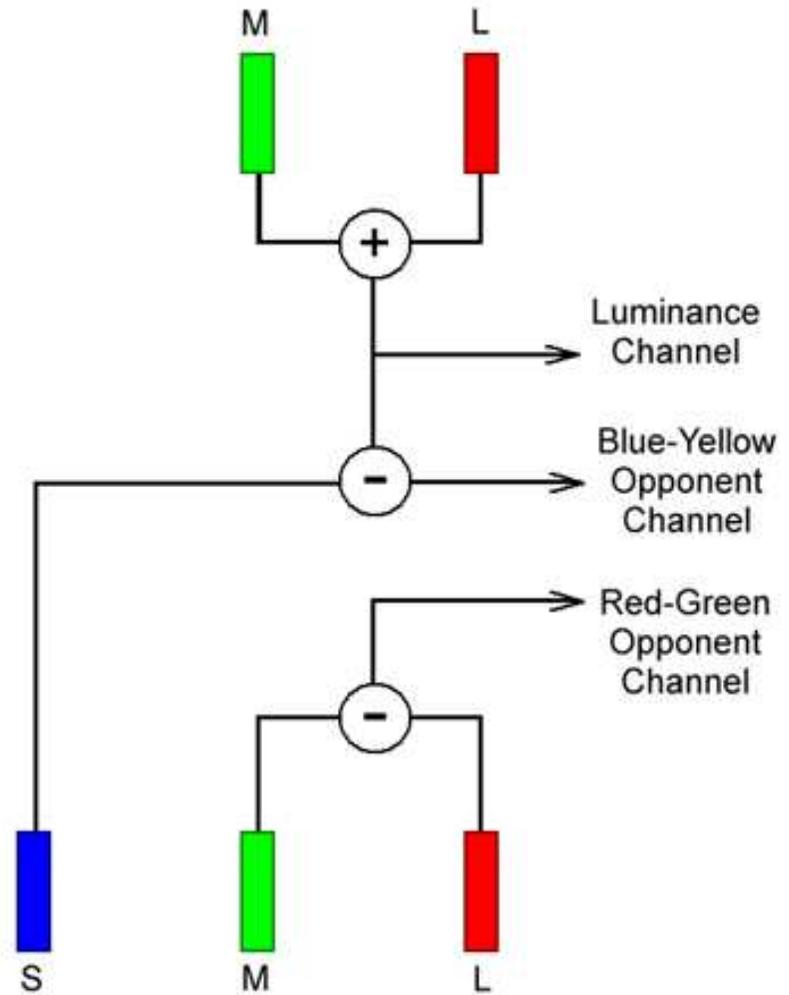
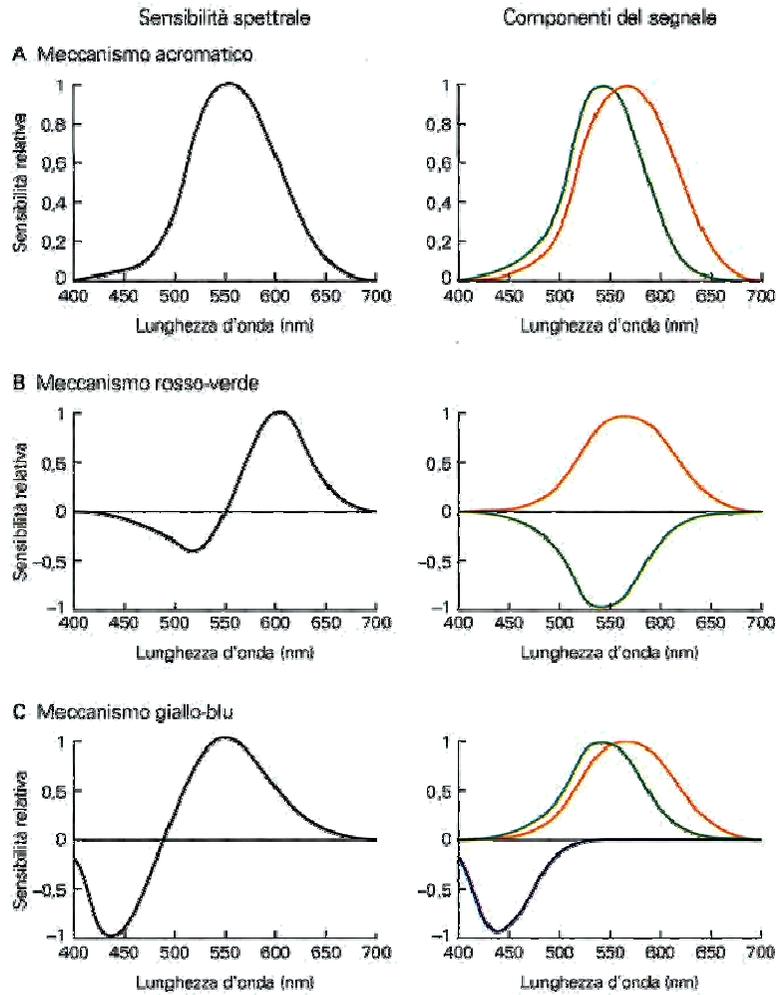
Tricromatico:

Dicromatico:  
protoanopia, deuteranopia, tritanopia

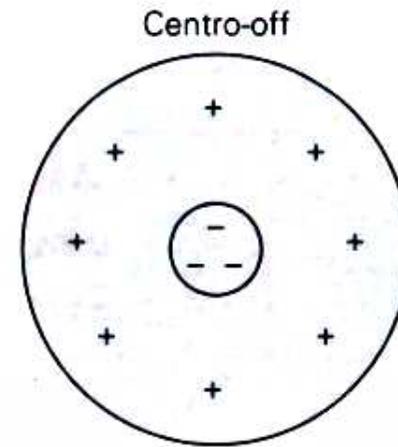
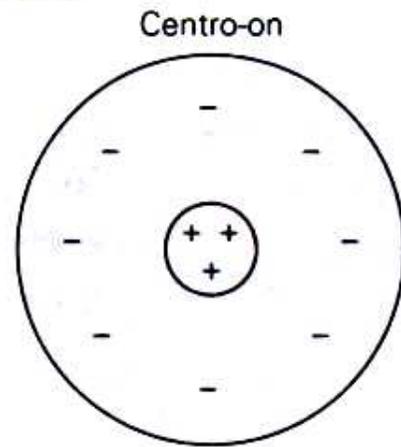
Acromatico:



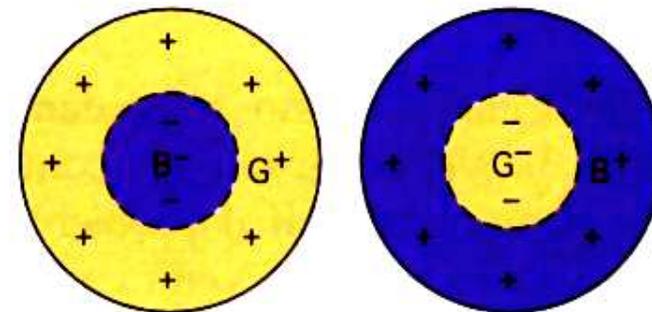
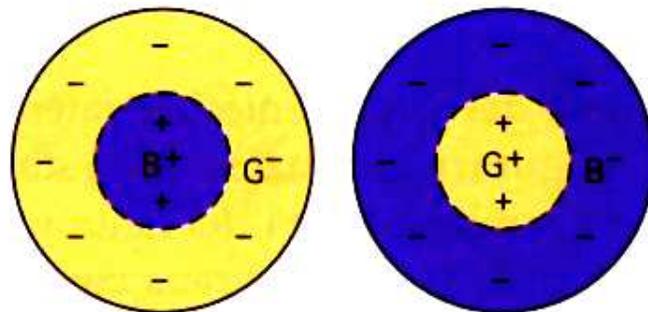
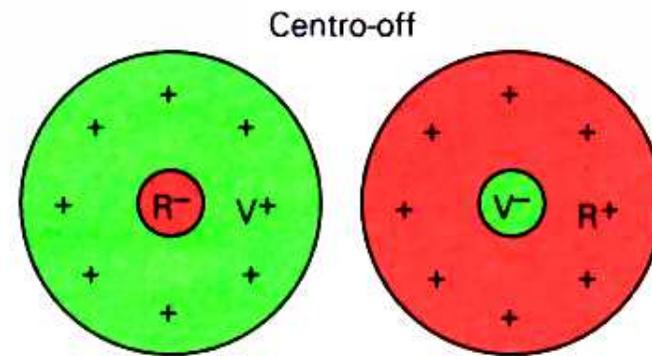
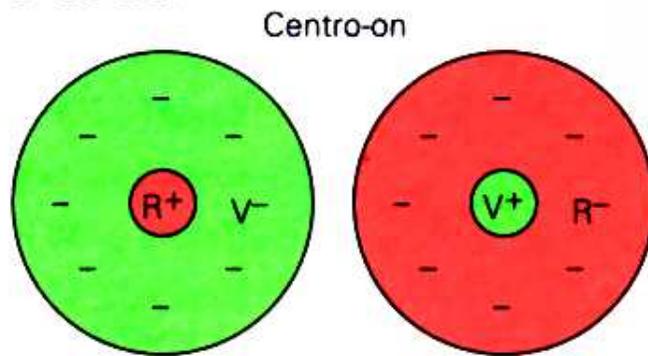
# Visione dei colori



A Cellule M

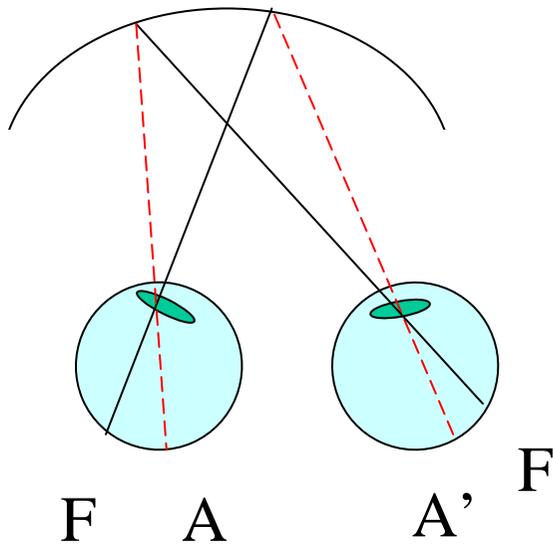


B Cellule P



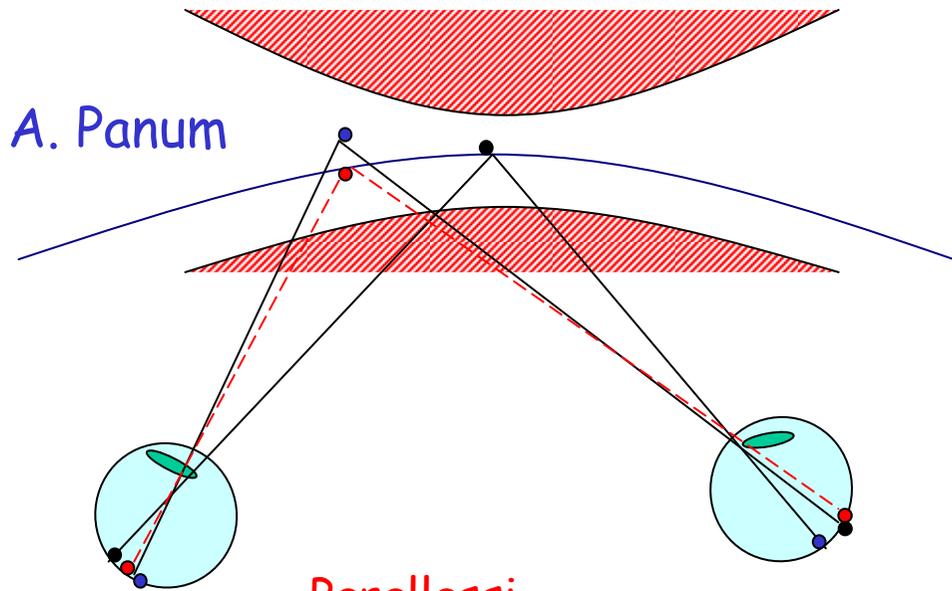
# Stereopsi

*Oroptero:*  
*punti corrispondenti*



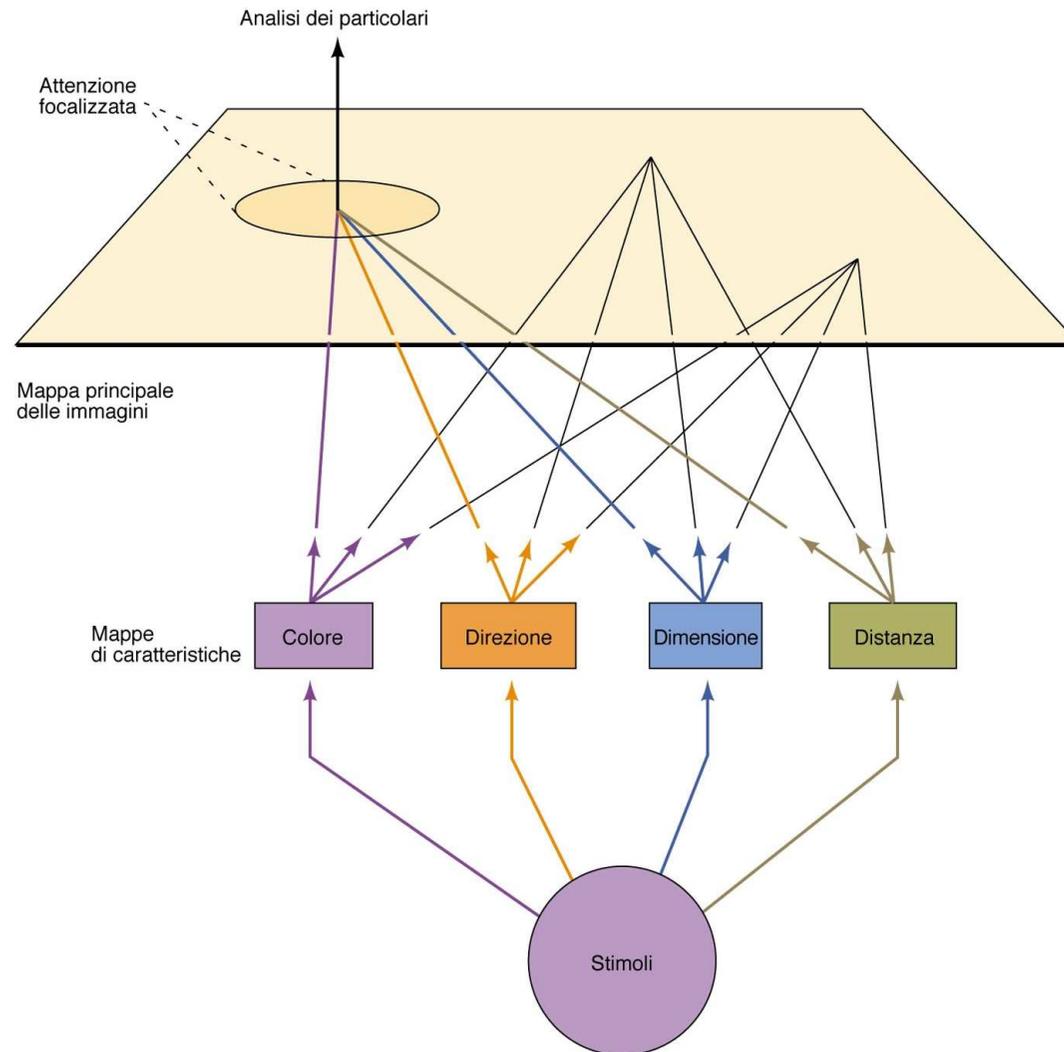
*Diplopia*  
*Disparità retinica*

A. Panum



Parallassi  
Prospettiva  
Sovrapposizione  
Ombre  
Familiarità  
Propettiva aerea

# *Analisi in parallelo*



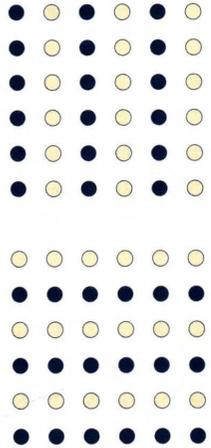
# Costruzione dell'immagine visiva

- Non è semplice registrazione
- E' interpretazione (Gestalt)
- prevalenza per somiglianza/ vicinanza ,  
figura/sfondo
- Illusioni: assunzioni per sagoma, riempimento,  
rapporti spaziali, nascondimento, illuminazione
- Attenzione visiva: momento preattenzionale analisi  
ascendente; processso attenzionale - analisi  
discendente: mappa delle salienze e rivalutazione

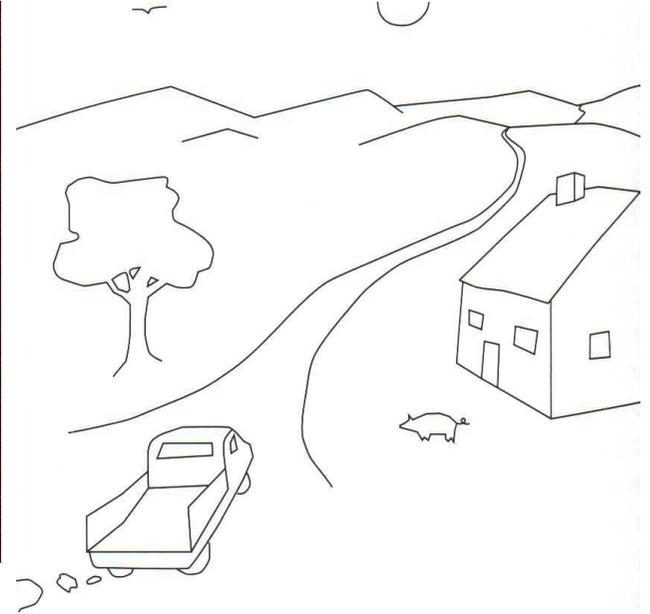
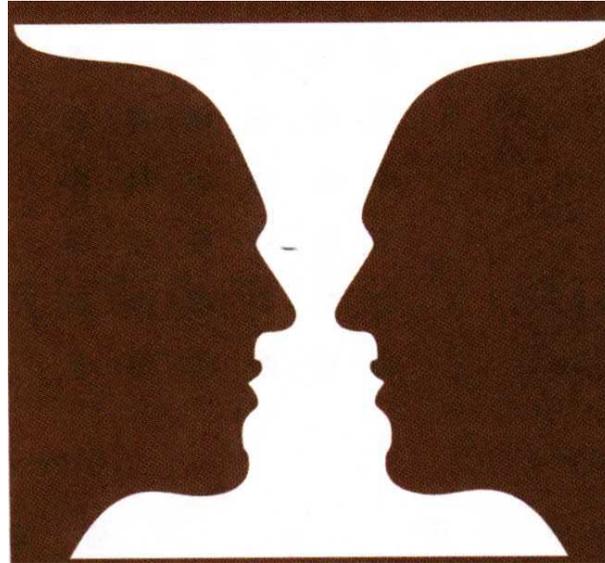
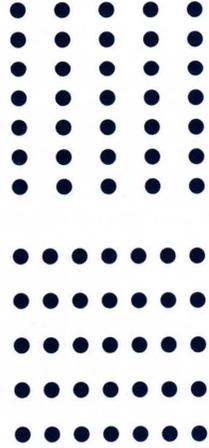
A Ambiguous pattern



B Similarity



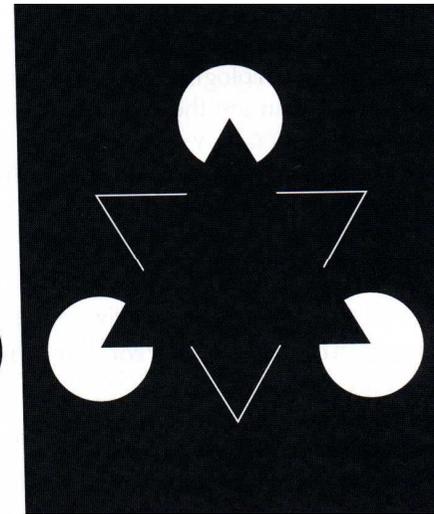
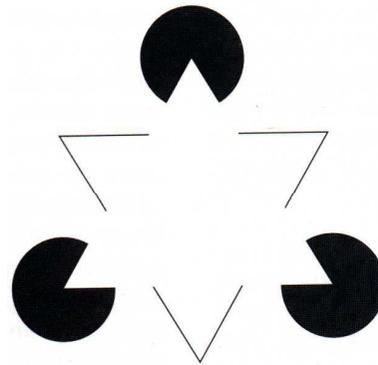
C Proximity

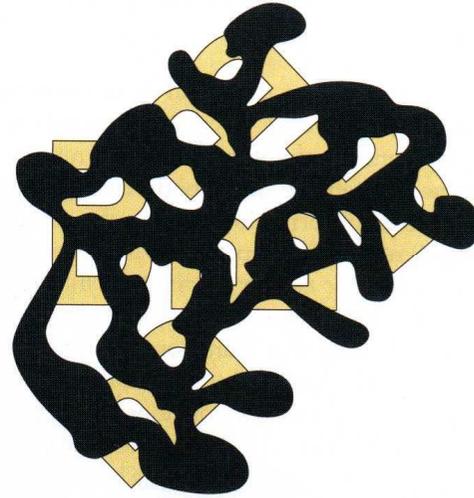
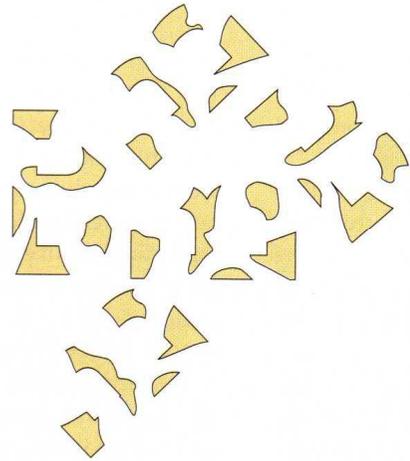
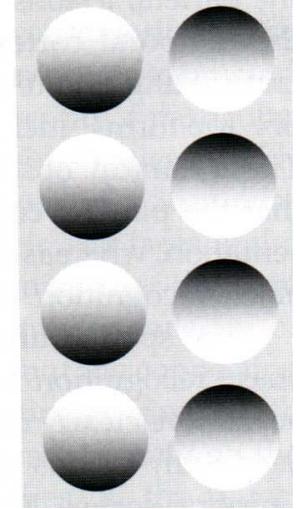
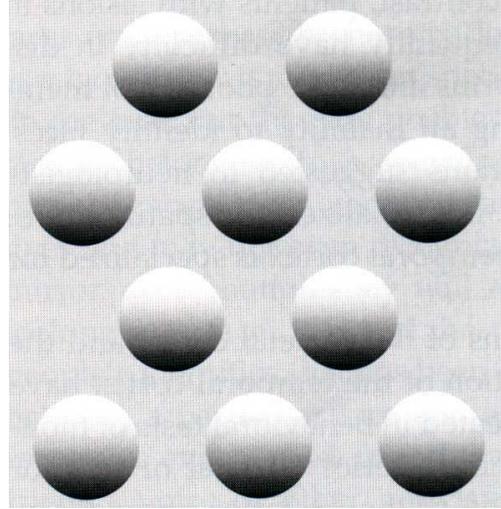


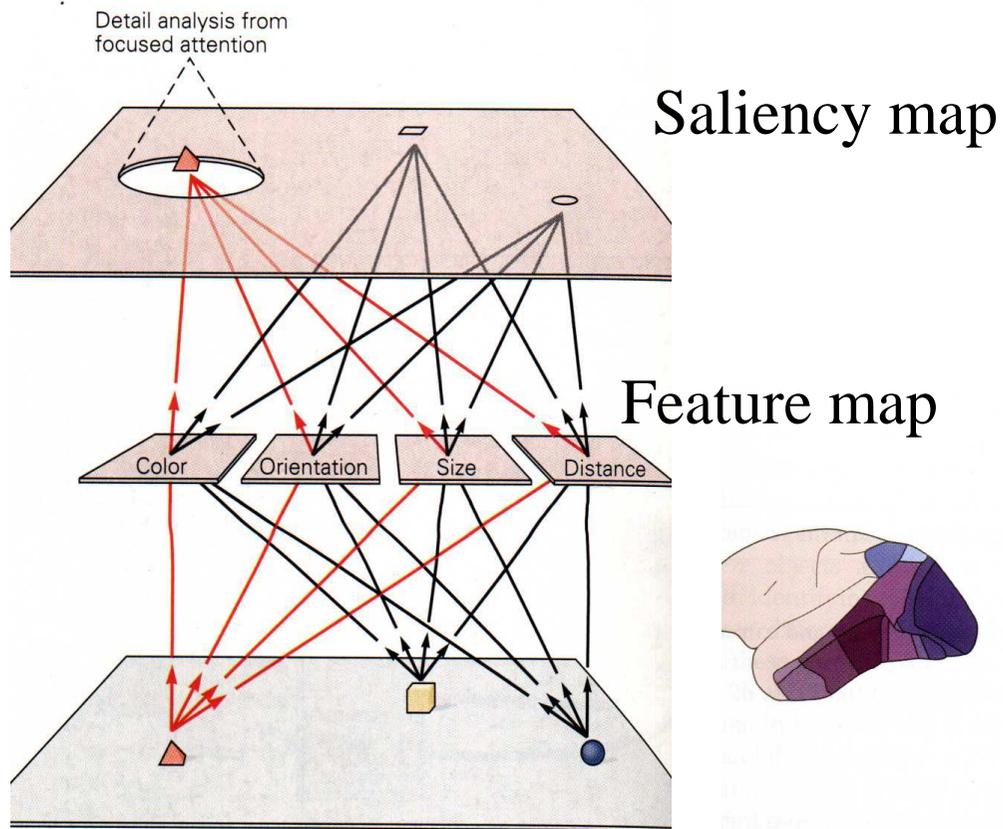
1



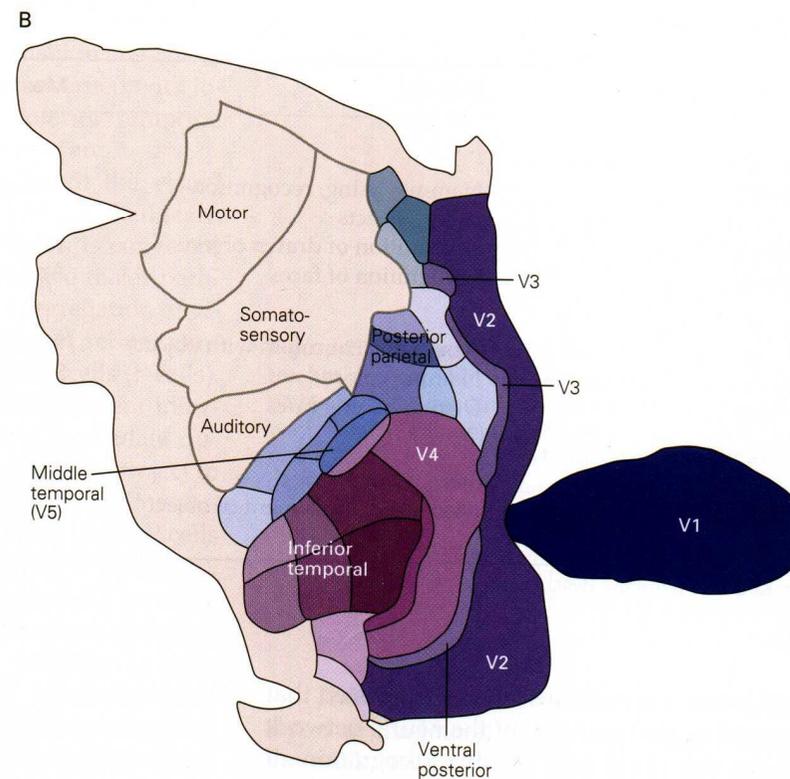
2







Analisi ampiezza campo  
 sincronismo  
 specifico pattern  
 mappe gerarchiche



Julez: preattentive (paral b-t) and  
 attentive processes (serial t-p)

# Riflessi

