

# DATA VISUALIZATION

*The Neurobiology of Vision and Perception*

**HELLO THERE!**

**IF SEEING IS BELIEVING...**





**HOW DO WE SEE?**

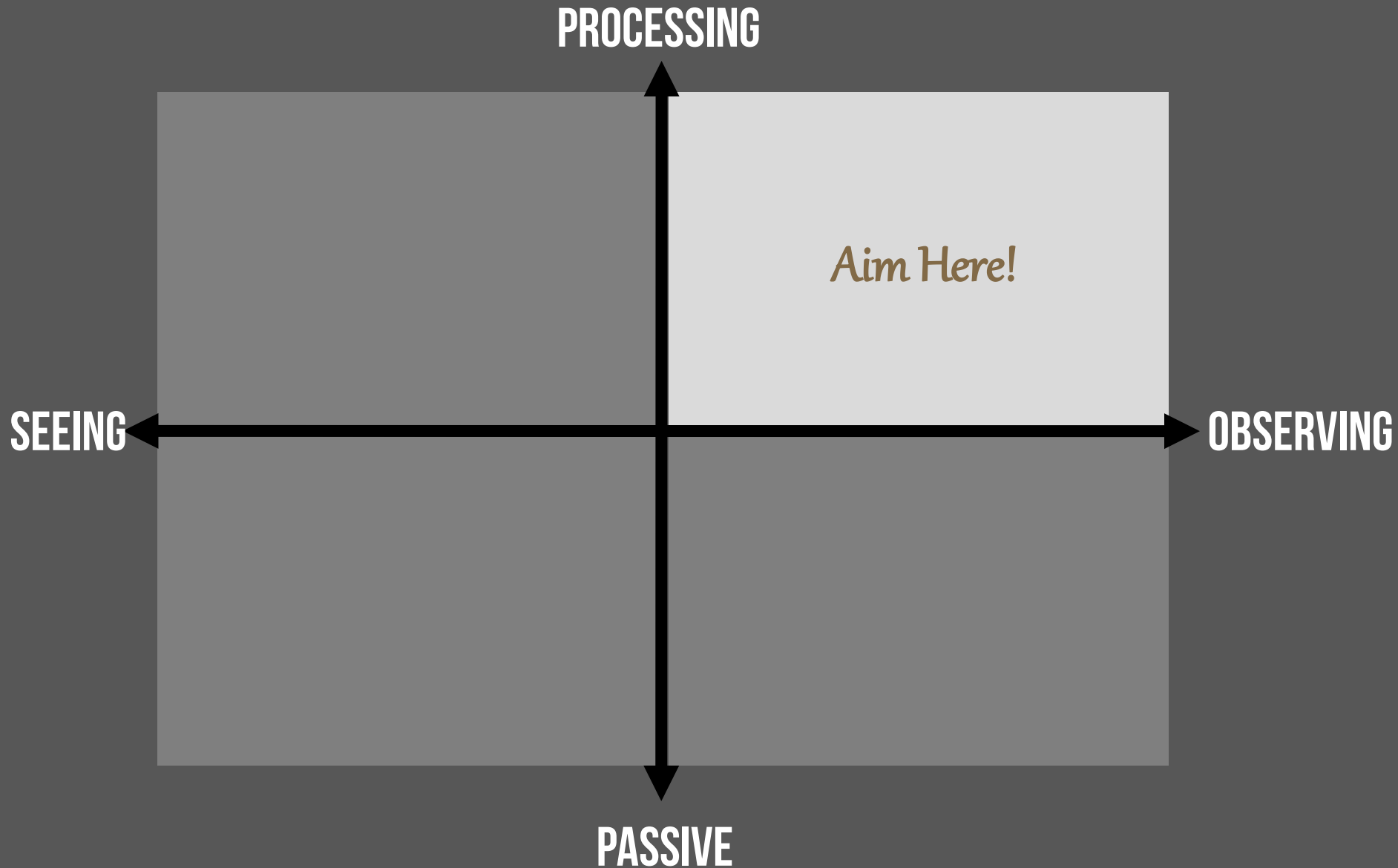


**1 | PHYSIOLOGY**

**2 | PSYCHOLOGY**

**3 | PERCEPTION**

# TODAY'S LECTURE

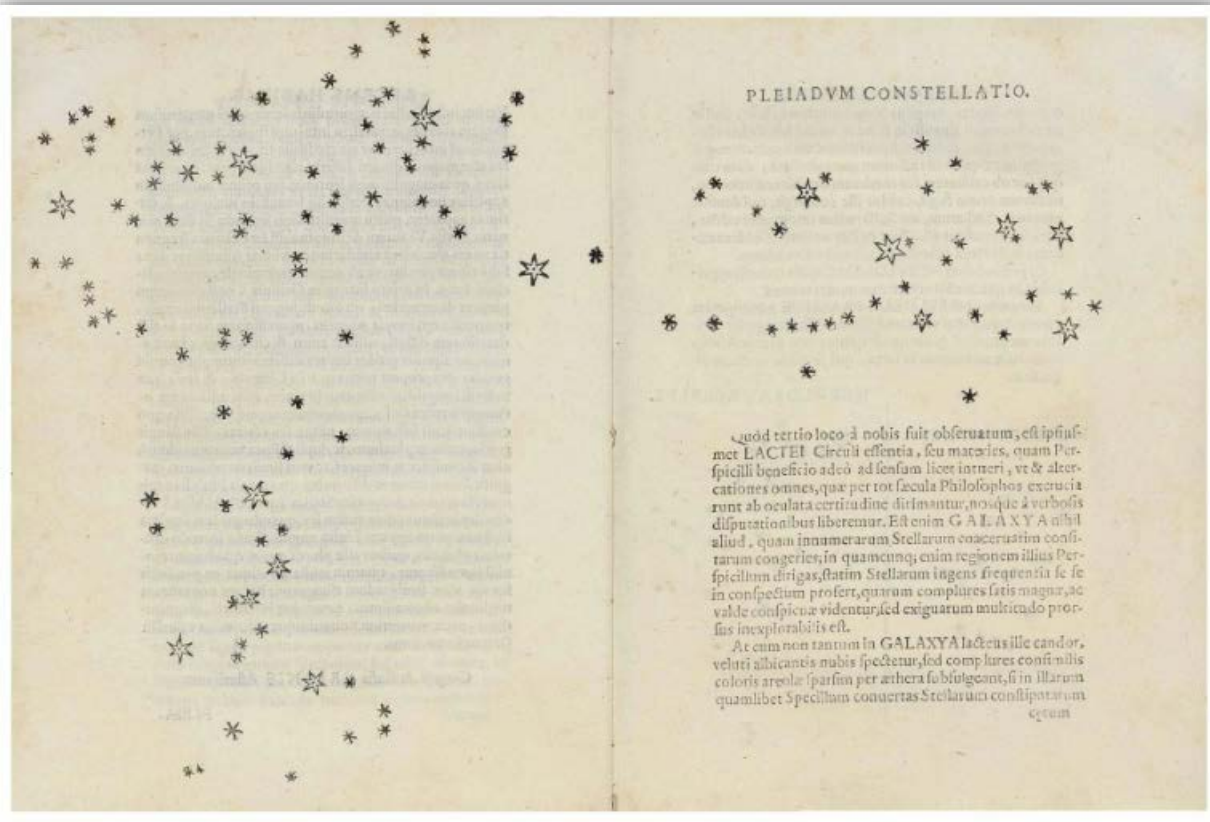




# 0 | FOUNDATIONS

**WHY IS VISION IMPORTANT?**





# OBSERVAT. SIDEREAE

Ori. \* \* \* \* \* Occ.

Stella occidentalis maior, ambae tamen valde con-  
spicuae, ac splendide: vera quae distabat à Iove scrupu-  
lis pulvis duobus; tertia quoque Stella apparere cepit  
hac tertia prius minime conspecta, quae ex parte  
orientali Iovem ferè tangebat, etiamque admodum o-  
bliqua. Omnes fuerunt in eadem recta, & secundum  
Eclipticæ longitudinem coordinatae.

Die decimatercia primam à me quatuor conspecta  
fuerunt Stellarum in hac ad Iovem constitutione. Erant  
quatuor, & una orientalis, lineam proximè

13 January

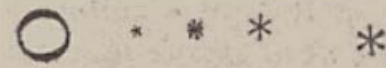


\* \* \* \* \* Occ.

lineabant; media enim occidentalis pau-  
culum à recta Septentrionis vixus declinabat. Abo-  
rat orientalis à Iove minoris duo; reliquarum, &  
Iovis interpedines erant singulae vixus tantum mi-  
nori. Stellarum omnes eandem praeferebant magnitu-  
dinem; ac licet exiguae, lucidissimae tamen erant, ac  
fixae, cuiusmodi magnitudinis longispermiores.

Die decimaquarta, hac nocte tertia in proximè  
linea habundant quatuor Stellarum ad Iovem;

15 January



\* \* \* \* \* Occ.

omnes; ac in eadem proximè recta linea  
dispositae, quae etiam tertia à Iove numerabatur pra-  
tulit.

sight

touch



computer network



USB key



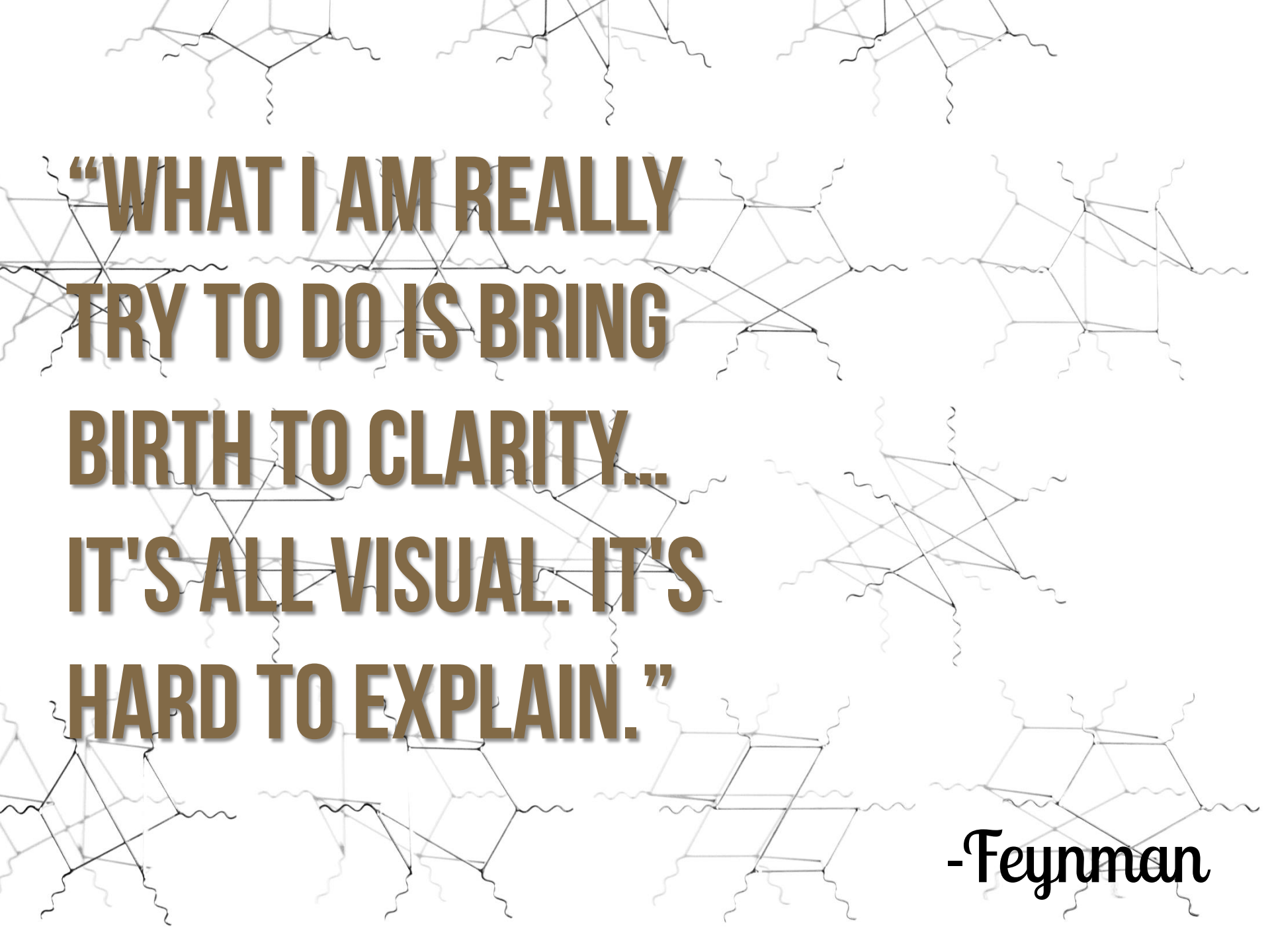
hard disk

hearing/smell

pocket calculator



taste

The background of the slide is filled with a repeating pattern of faint, light-gray Feynman diagrams. These diagrams consist of various geometric shapes like triangles and hexagons, interconnected by straight lines and wavy lines, representing particle interactions in quantum field theory.

**“WHAT I AM REALLY  
TRY TO DO IS BRING  
BIRTH TO CLARITY...  
IT'S ALL VISUAL. IT'S  
HARD TO EXPLAIN.”**

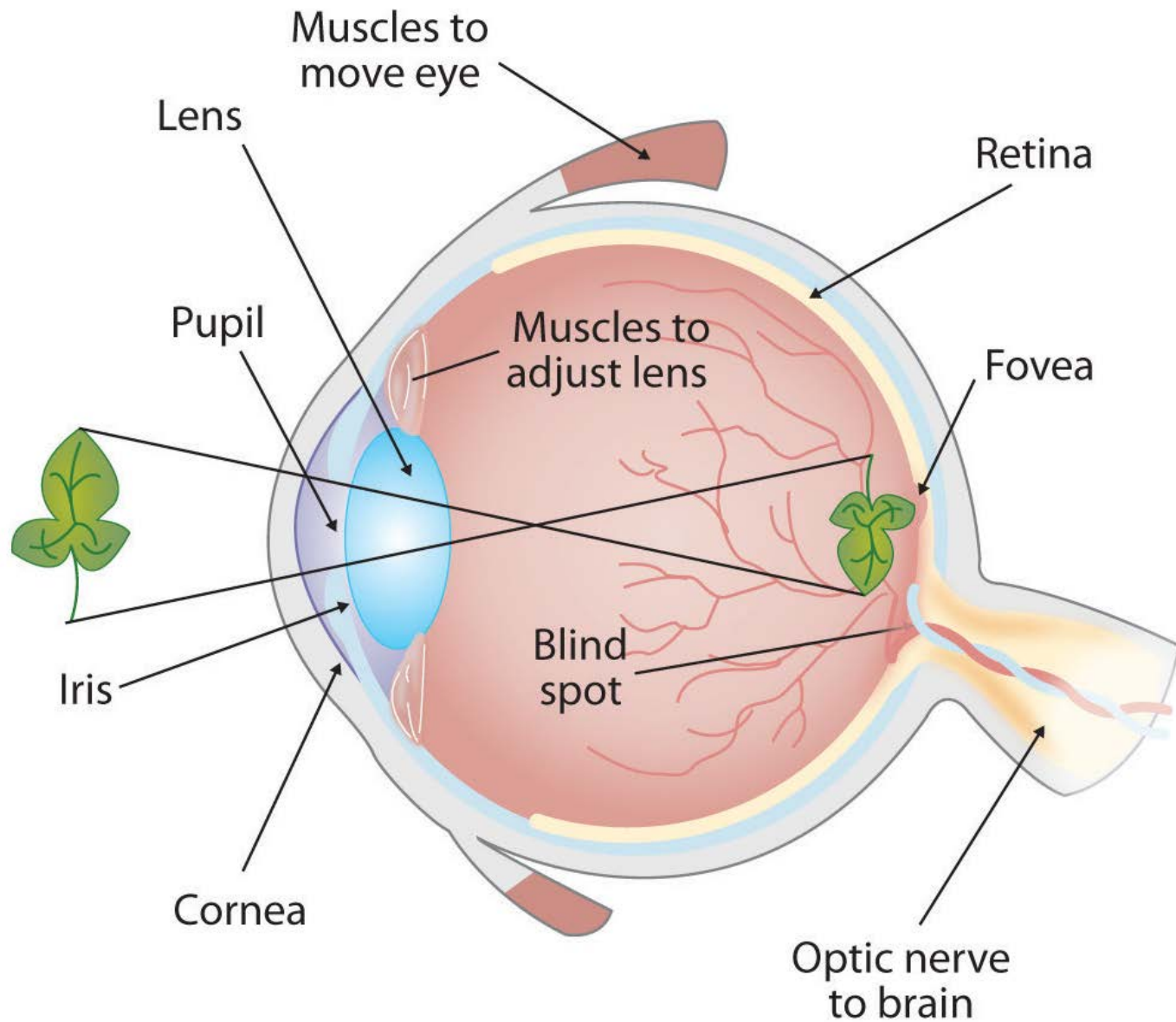
**-Feynman**

# 1 | PHYSIOLOGY





# **VISUAL BIOLOGY**





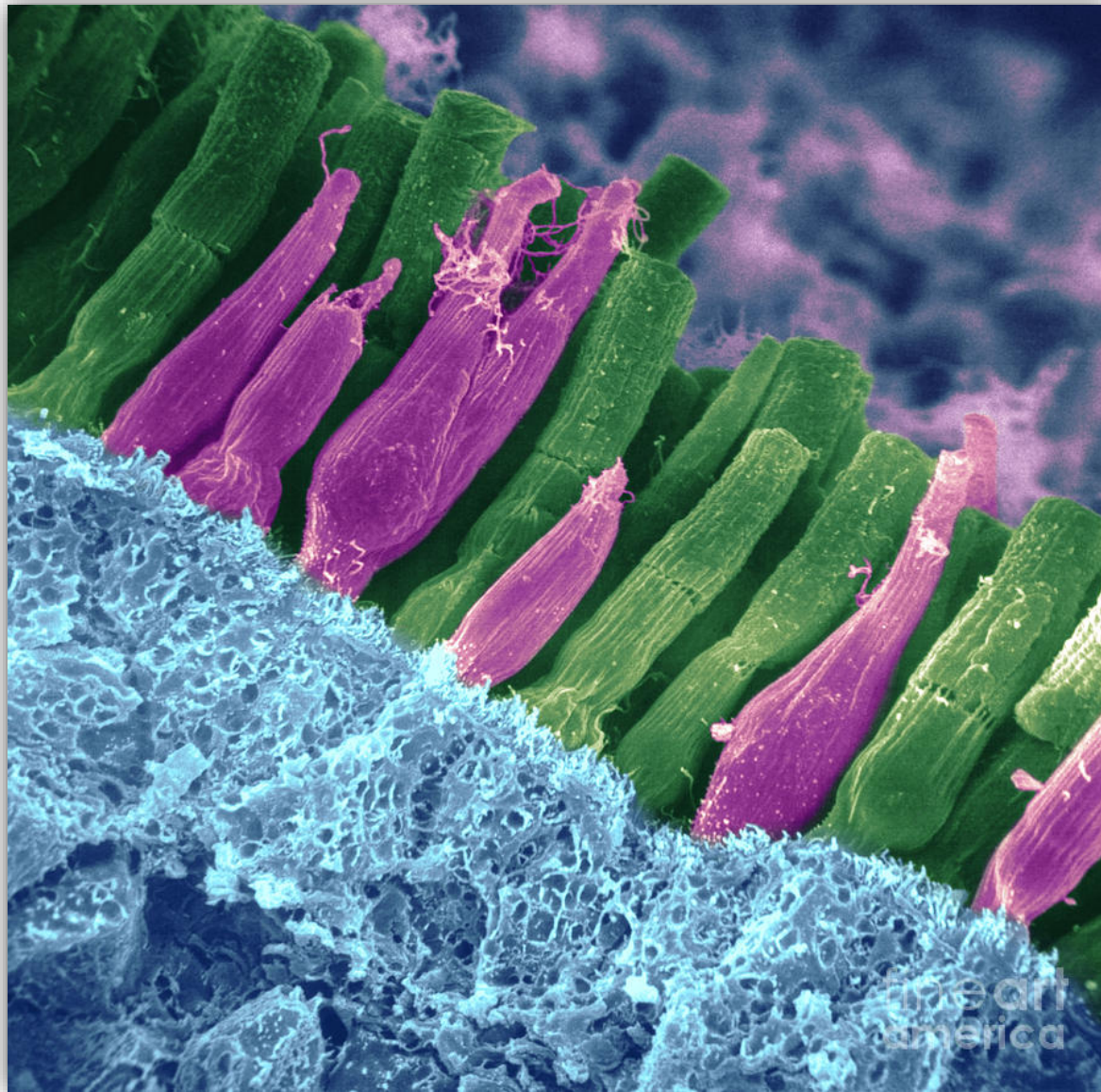
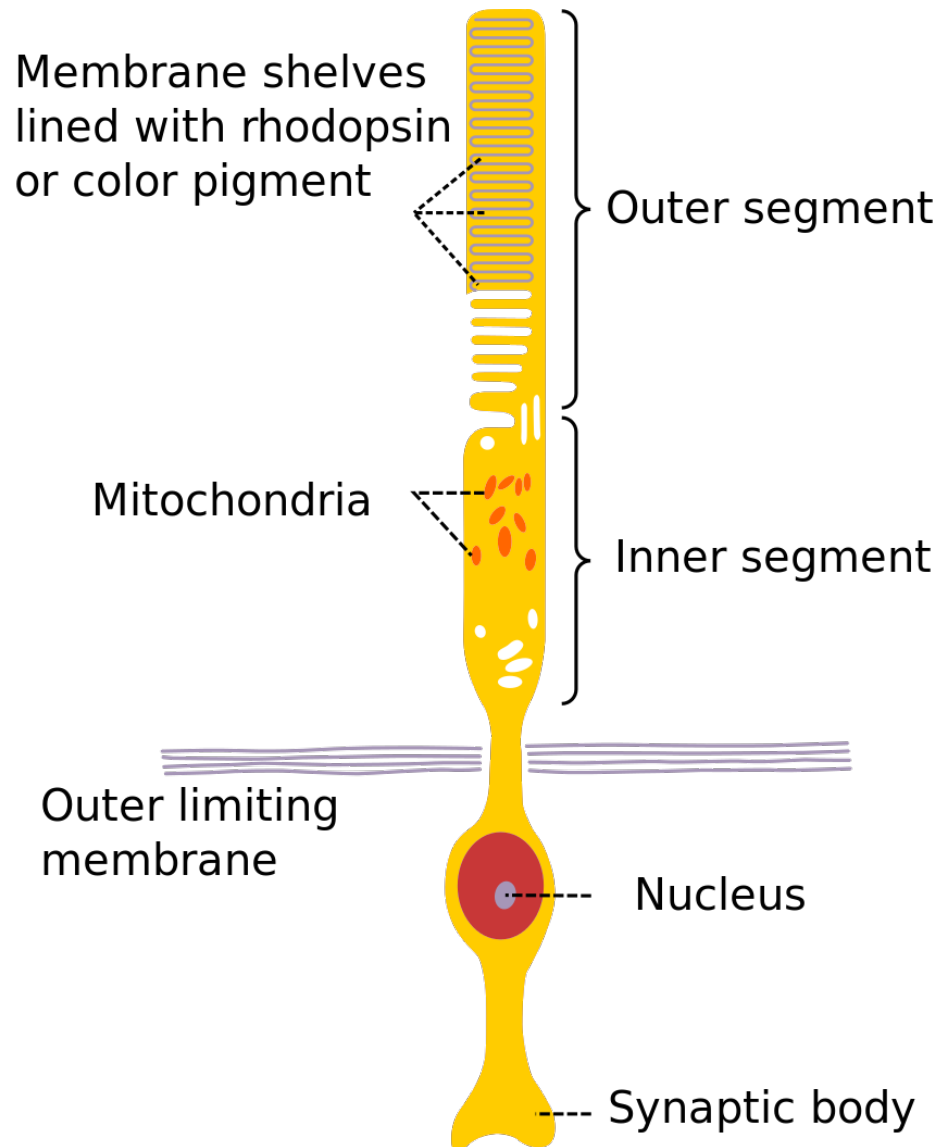
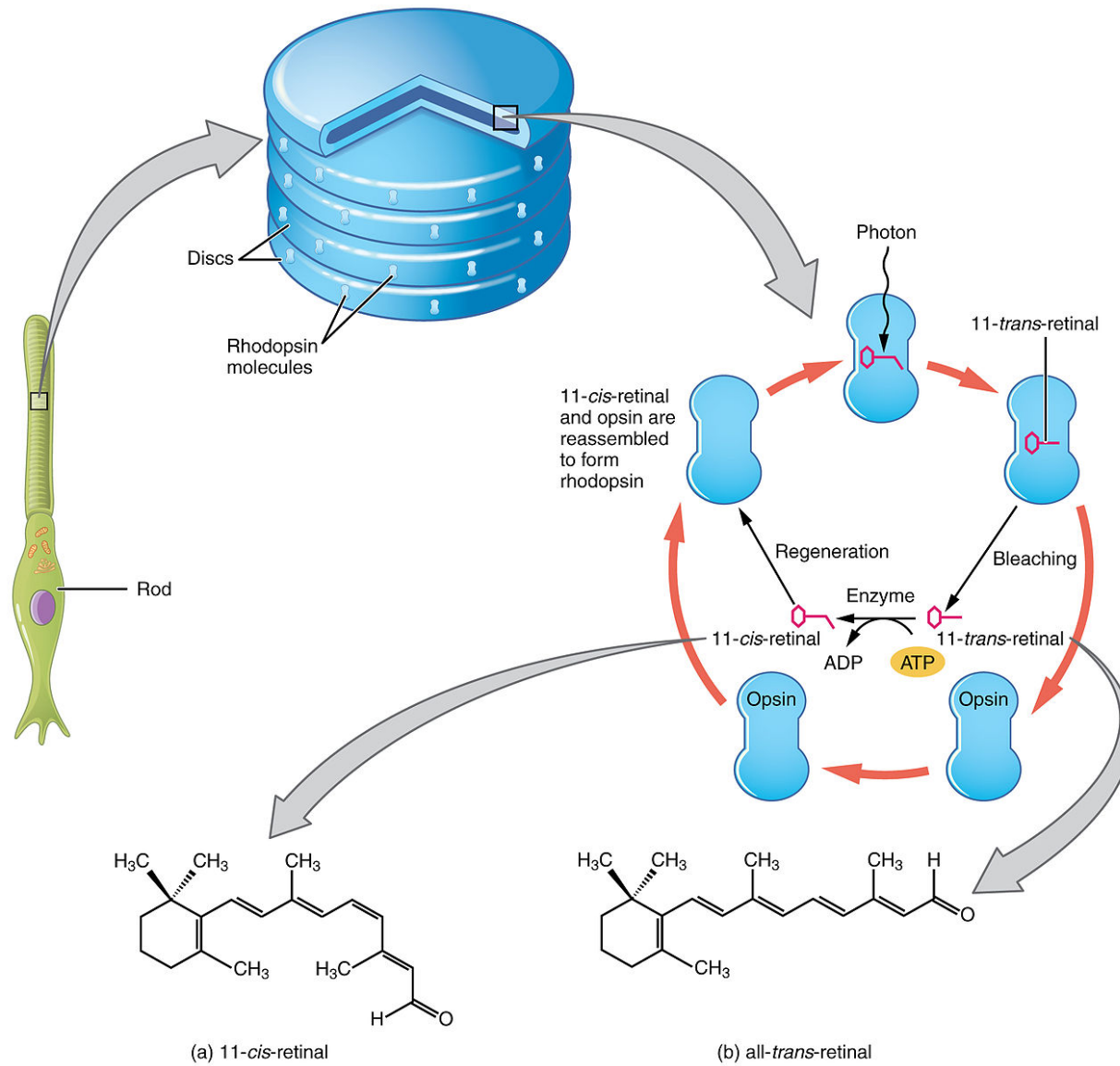
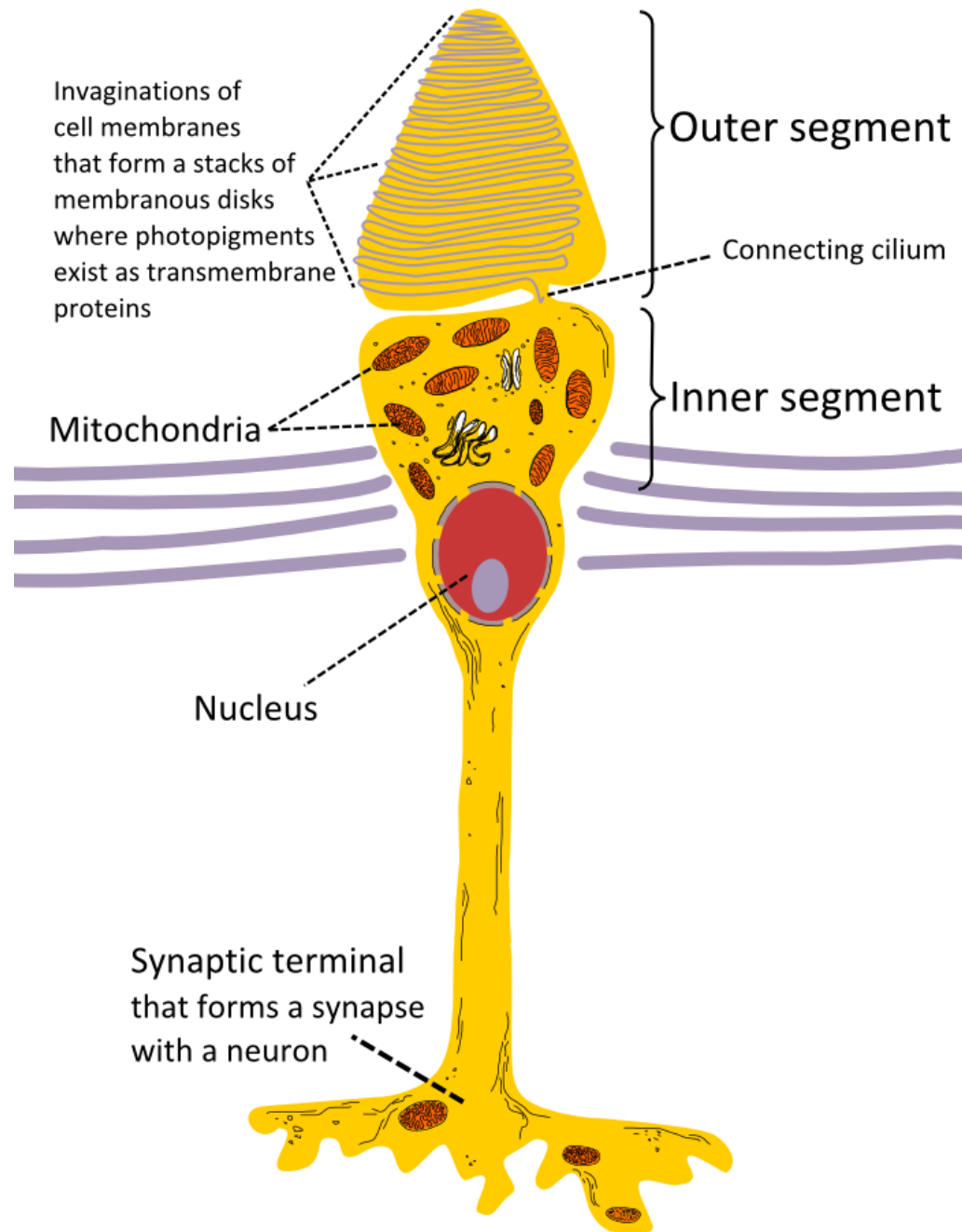


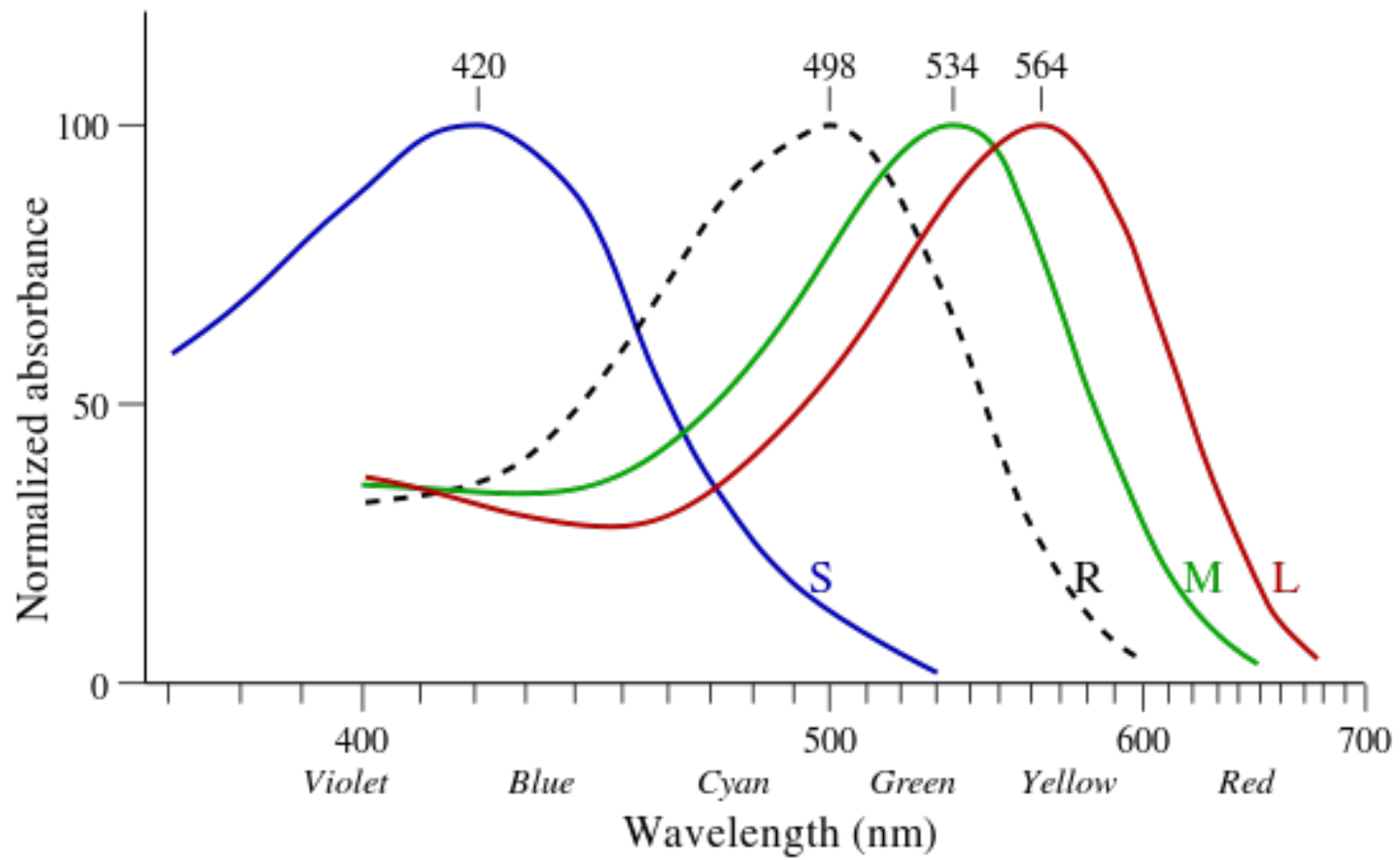
Image from [fineartamerica.com](https://www.fineartamerica.com)



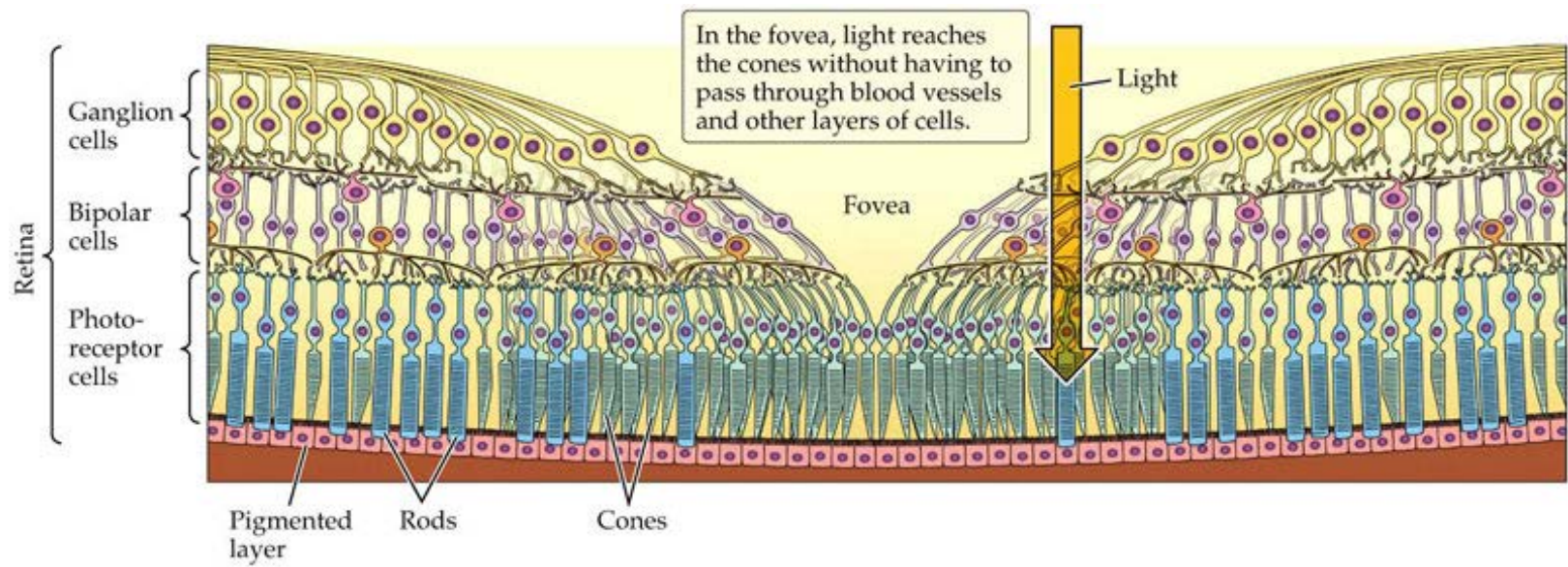


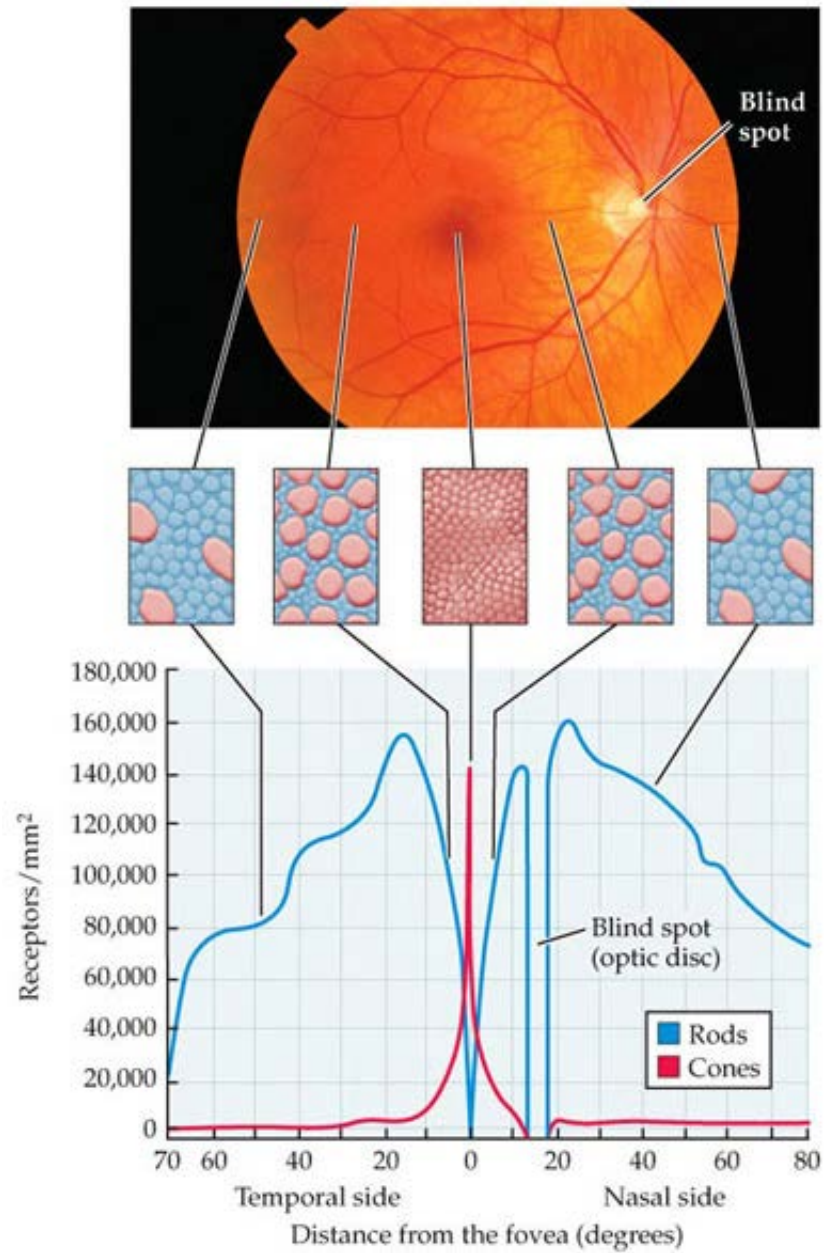


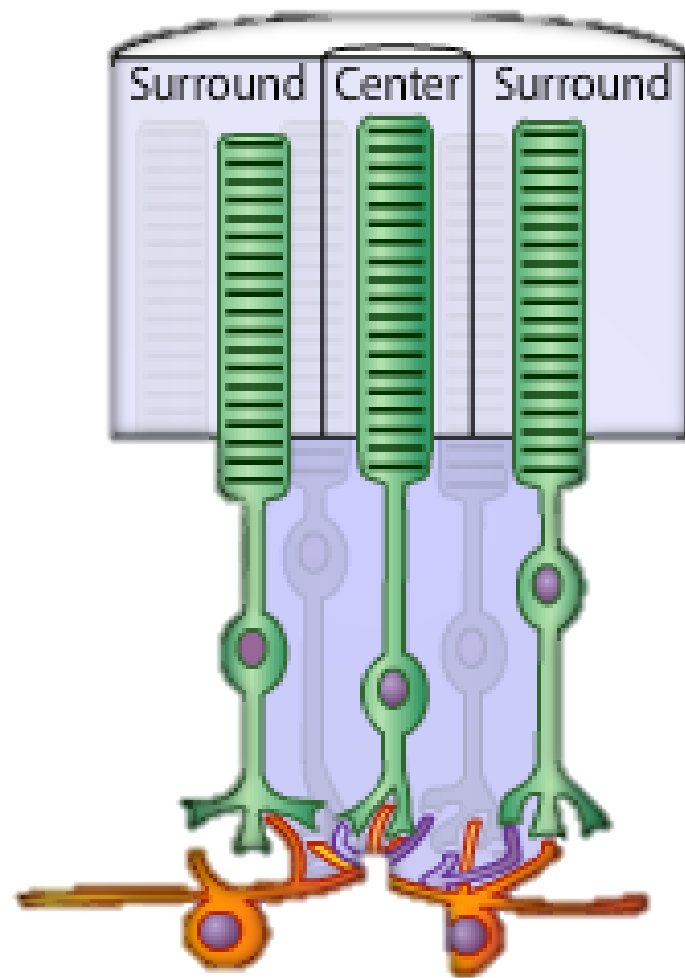


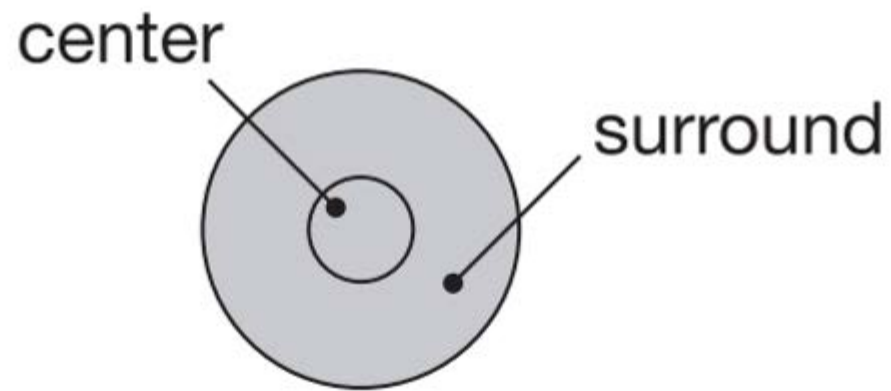






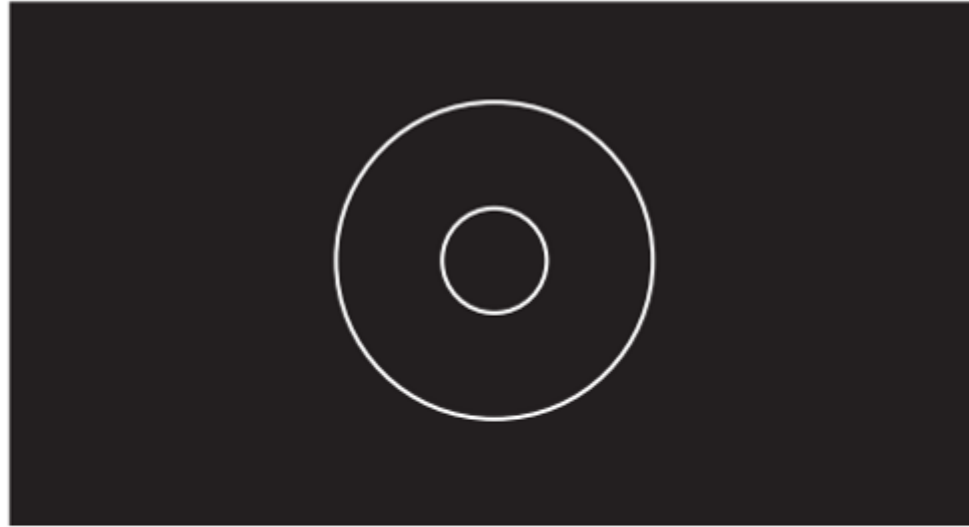




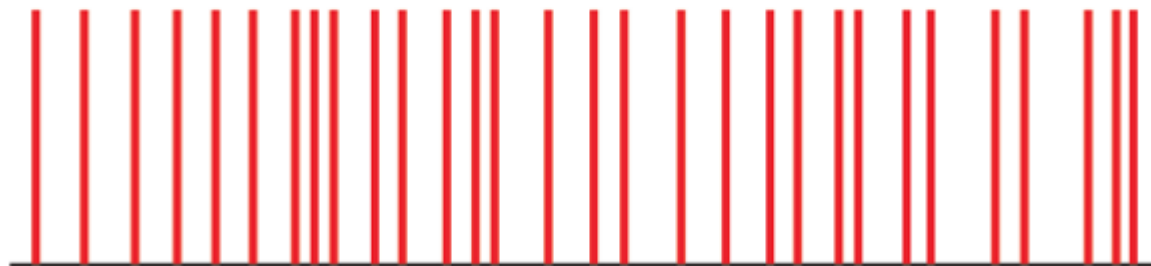
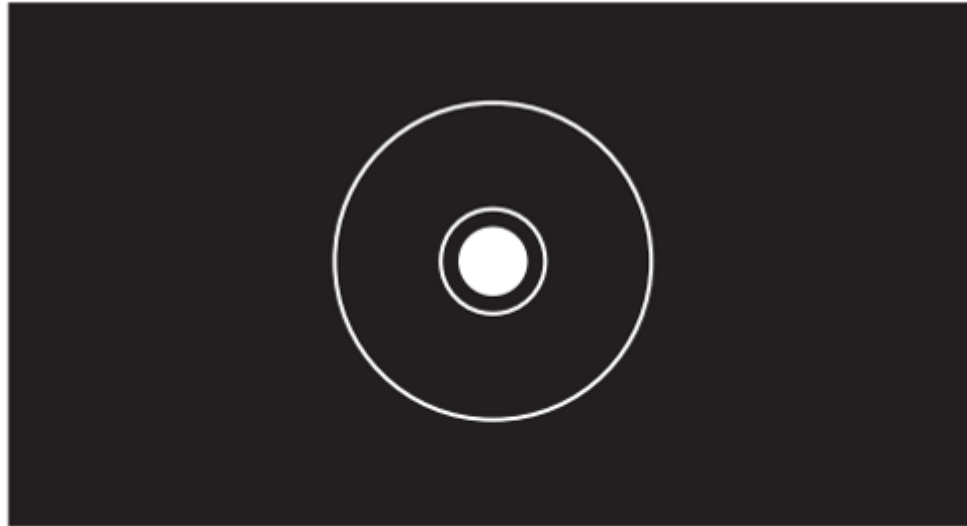




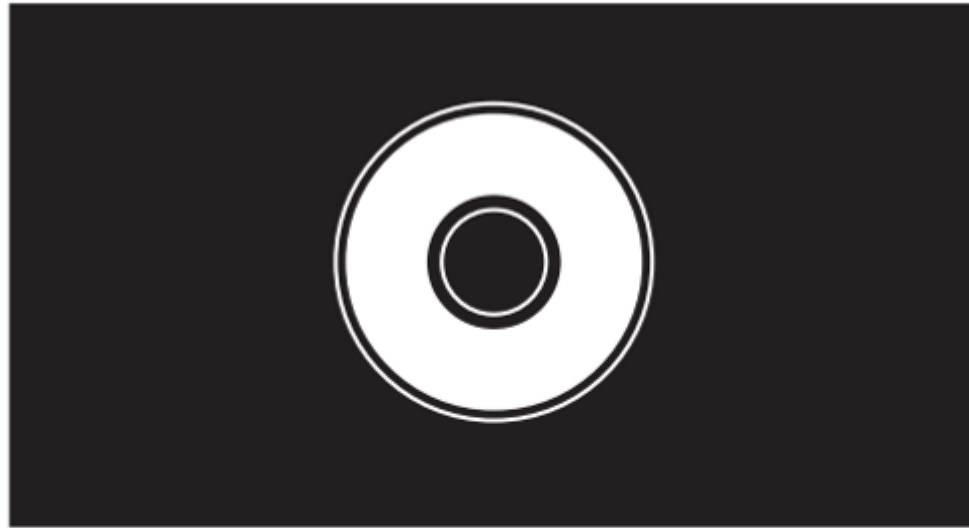
DARK



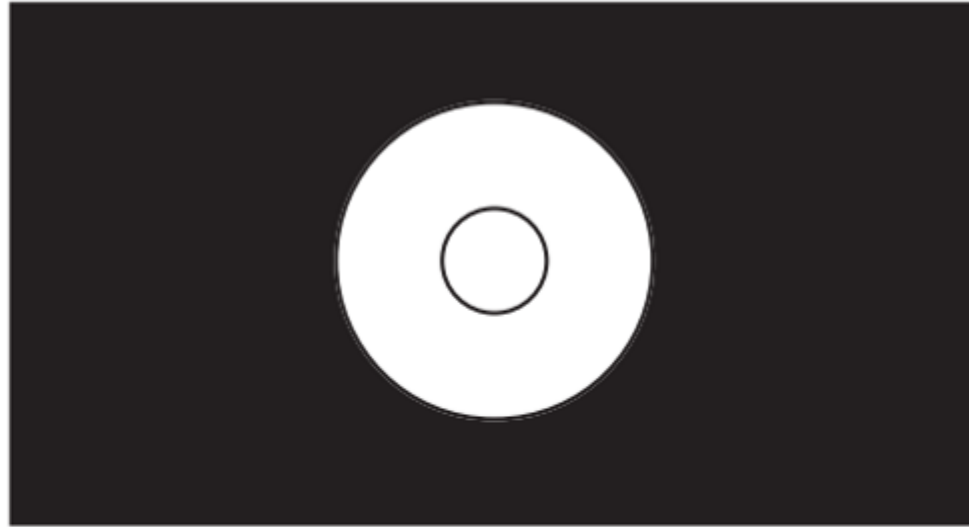
baseline rate



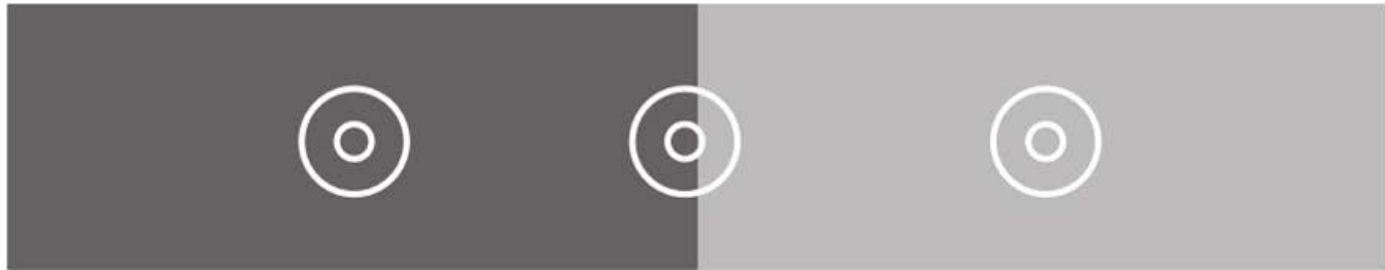
above baseline rate

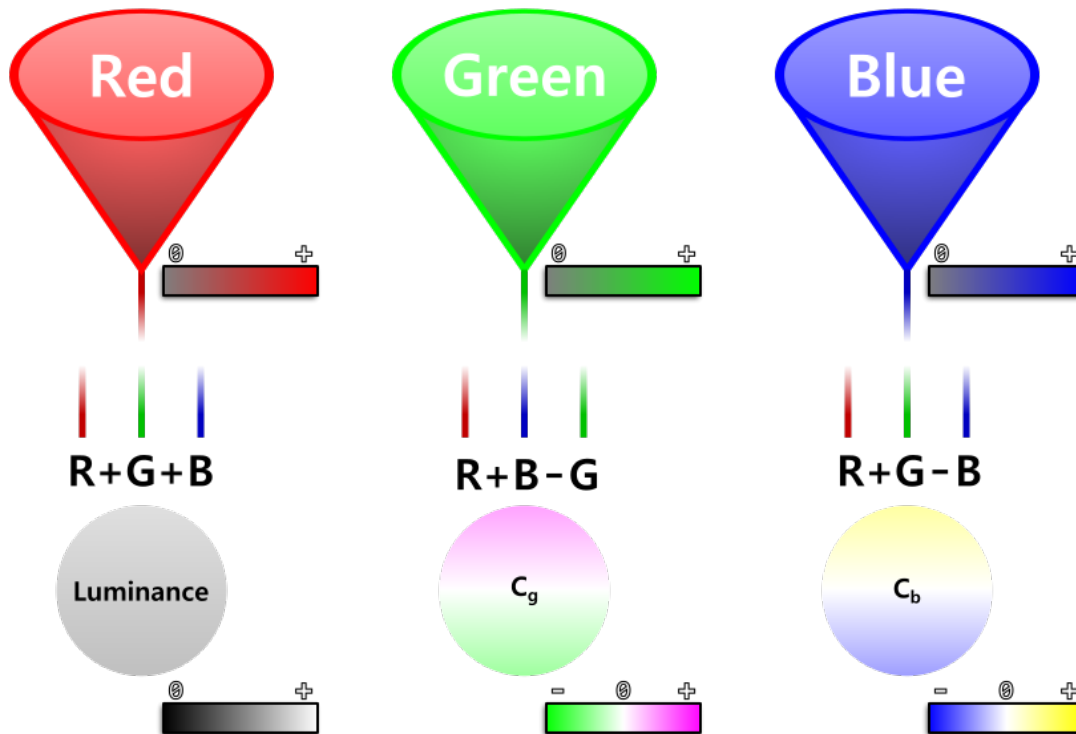


below baseline rate



baseline rate





## 1. Trichromatic Stage

Trichromatic cone cells respond positively to one of three frequencies exhibited by photons arriving on their surface.

## 2. Opponent Process Stage

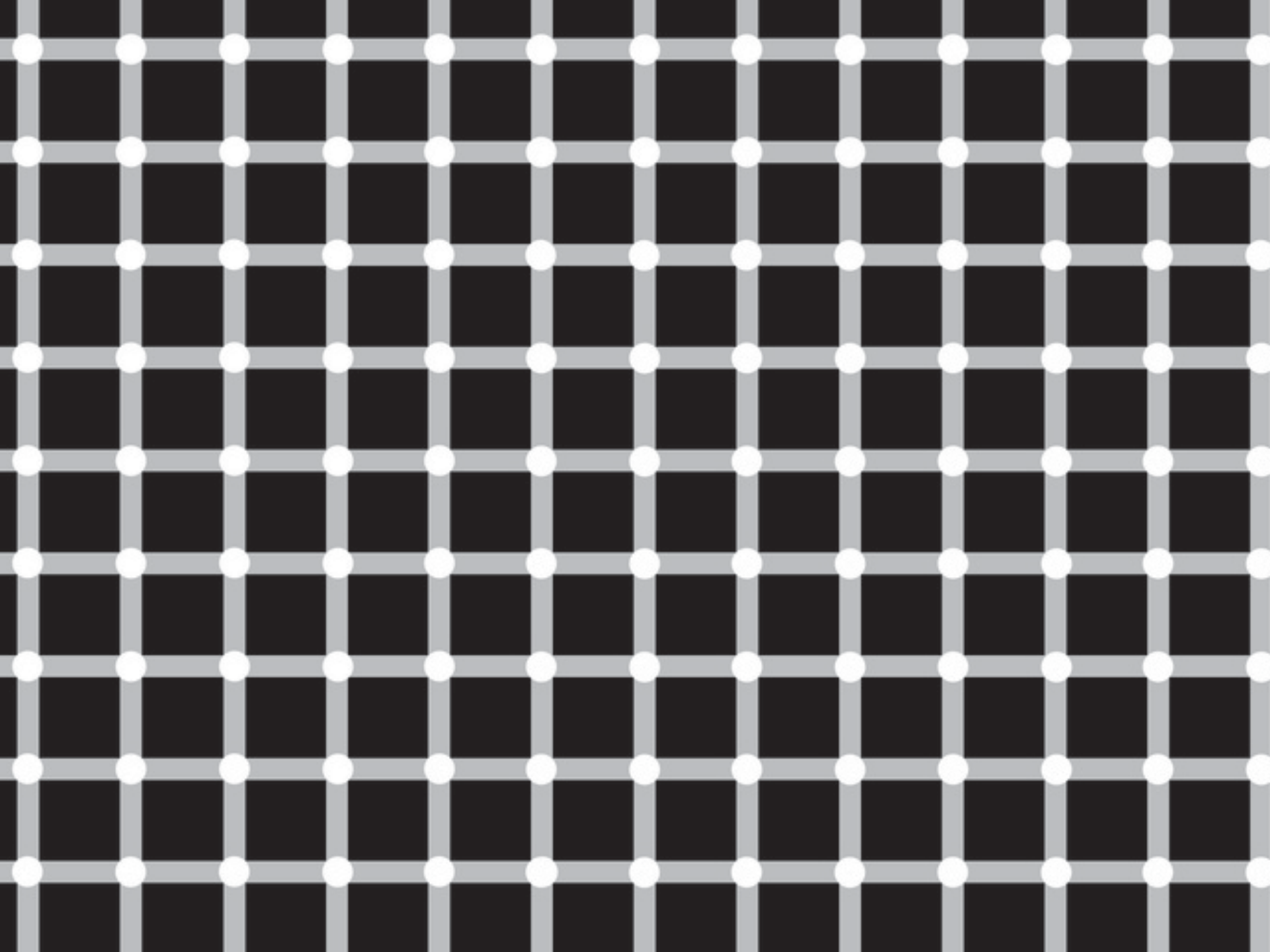
The three color channels are discovered by nearby opponent cells.

Opponent cells tuned to luminosity are excited by the red, green, and blue color signals.

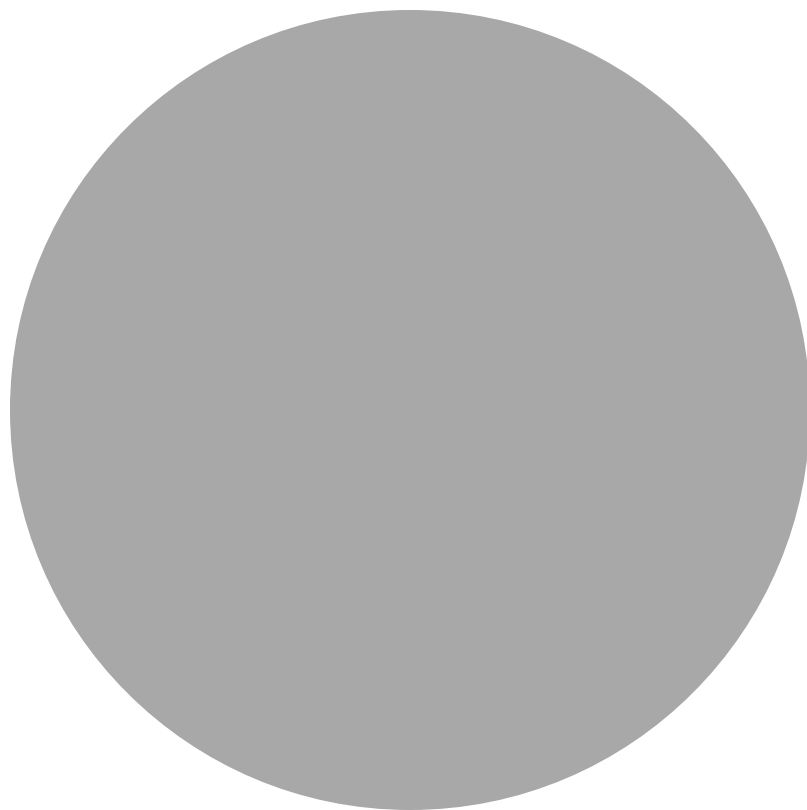
$C_g$  cells are excited by red and blue and inhibited by green.  $C_b$  cells are excited by red and green and inhibited by blue.



**EYES RESPOND TO  
DIFFERENCES IN INTENSITY**

















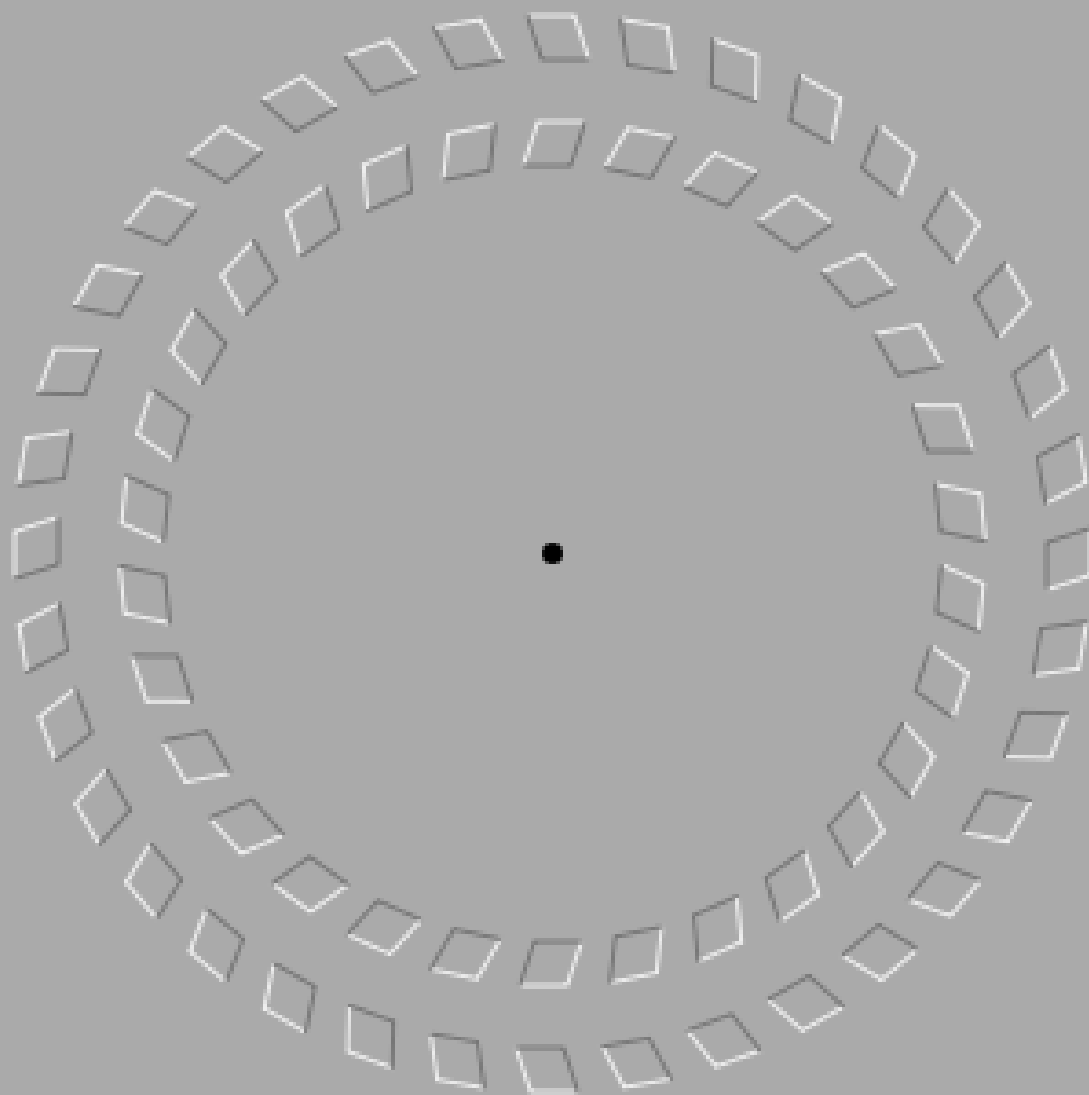


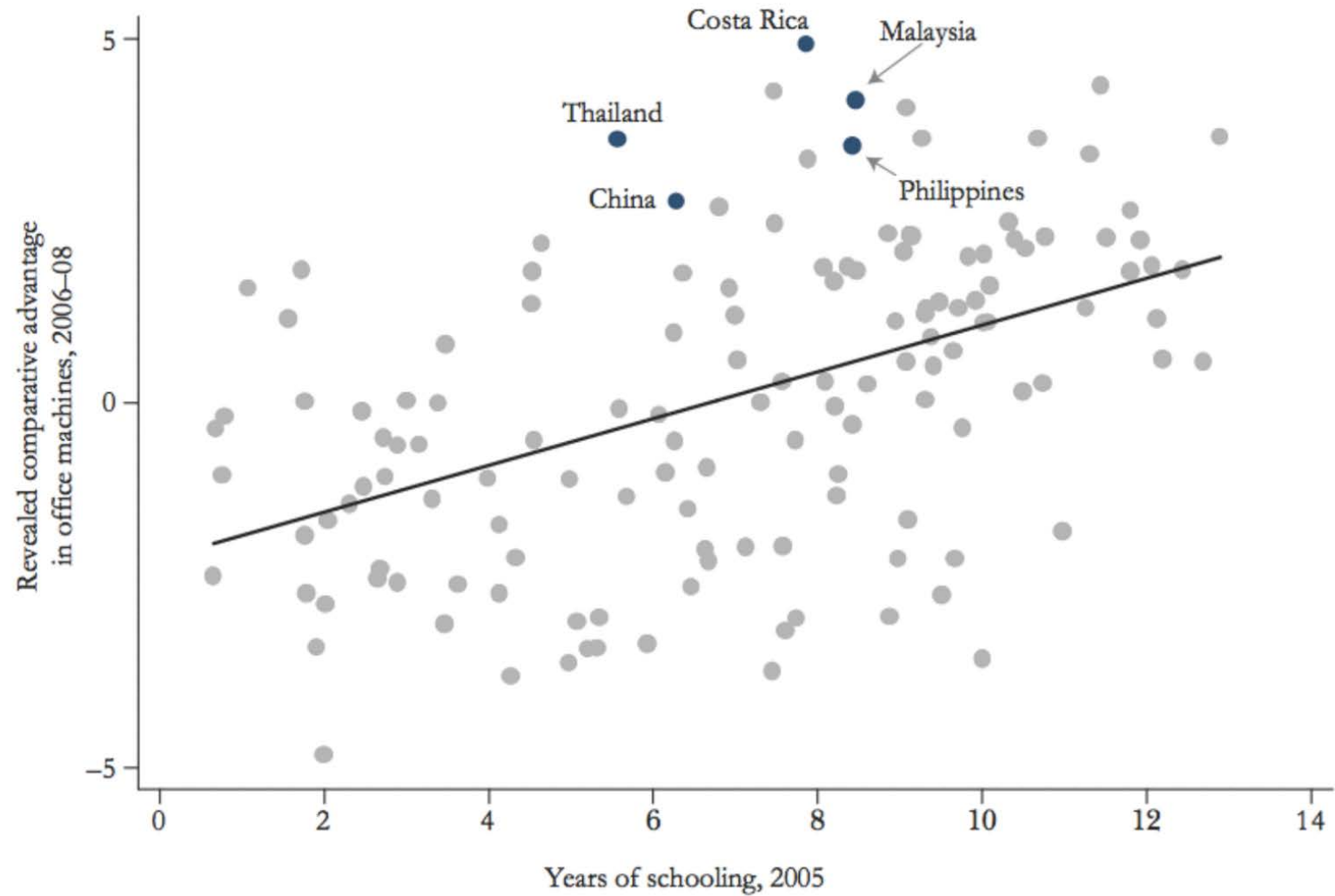
Image from Baingio Pinna, Gavin J. Brelstaff

**USE VISUAL PRINCIPLES TO CREATE A  
HIERARCHY OF IMPORTANCE**



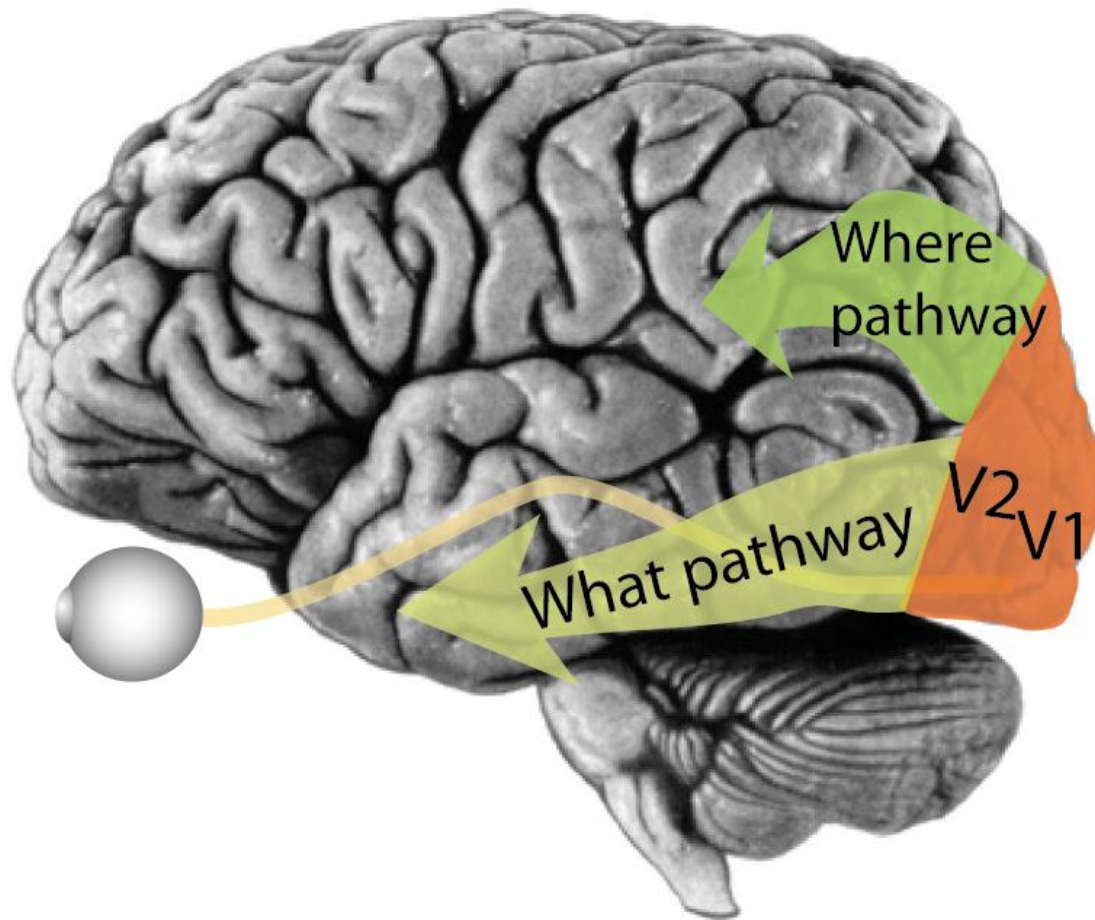
[illegible]

## Education and Exports of Office Machines



# 2 | PSYCHOLOGY

# VISUAL PROCESSING





# WHERE PATHWAY

**COLOR BLIND**

**FAST**

**LOW ACUITY**

**HIGH CONTRAST SENSITIVITY**

**MOTION PERCEPTION**

**DEPTH PERCEPTION**

**SPATIAL ORGANIZATION**

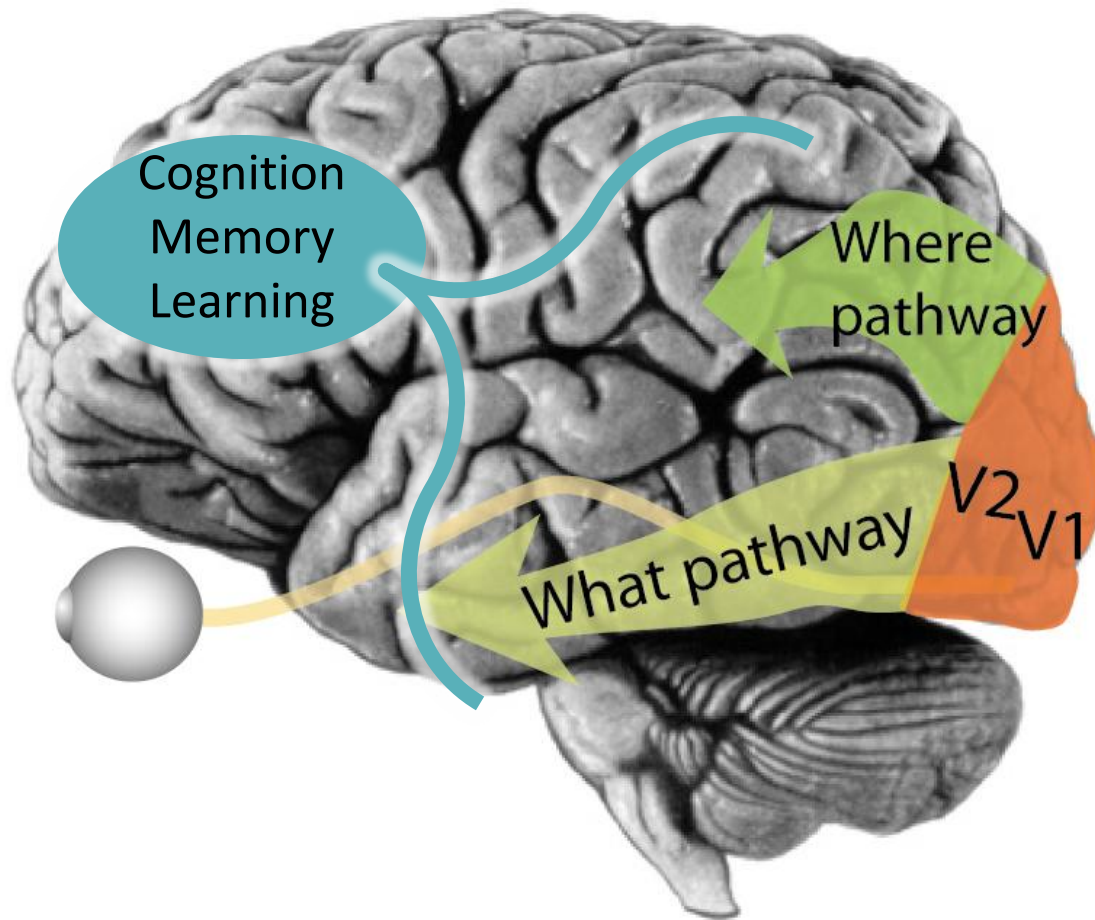
**FIGURE/GROUND SEPARATION**

# WHAT PATHWAY

**COLOR SELECTIVE**  
**SLOW**  
**HIGH ACUITY**  
**LOW CONTRAST SENSITIVITY**

**OBJECT RECOGNITION**  
**FACE RECOGNITION**  
**COLOR PERCEPTION**

**OBJECTS ARE PROCESSED DIFFERENTLY  
THAN LOW LEVEL FEATURES**



# MENTAL MODELS

**PEOPLE DON'T REMEMBER  
FACTS — THEY REMEMBER  
MENTAL MODELS**

**YOUR MENTAL MODEL MAY  
BE DIFFERENT THAN MINE**

**MUCK WITH MODELS**

**YOU WILL SEE AN OLD HAG**

**YOU WILL SEE A YOUNG LADY**





**MENTAL MODELS HELP US PROCESS QUICKLY  
BUT CAN BE DIFFICULT TO RECOGNIZE AND CHANGE**

**SOME TIPS AND TRICKS ARE COVERED BY  
PREATTENTIVE PROCESSING AND GESTALT THEOREMS**

**ENTER STEVEN!!**

# 3 | PERCEPTION

# 4 | COLOR (TEASER)

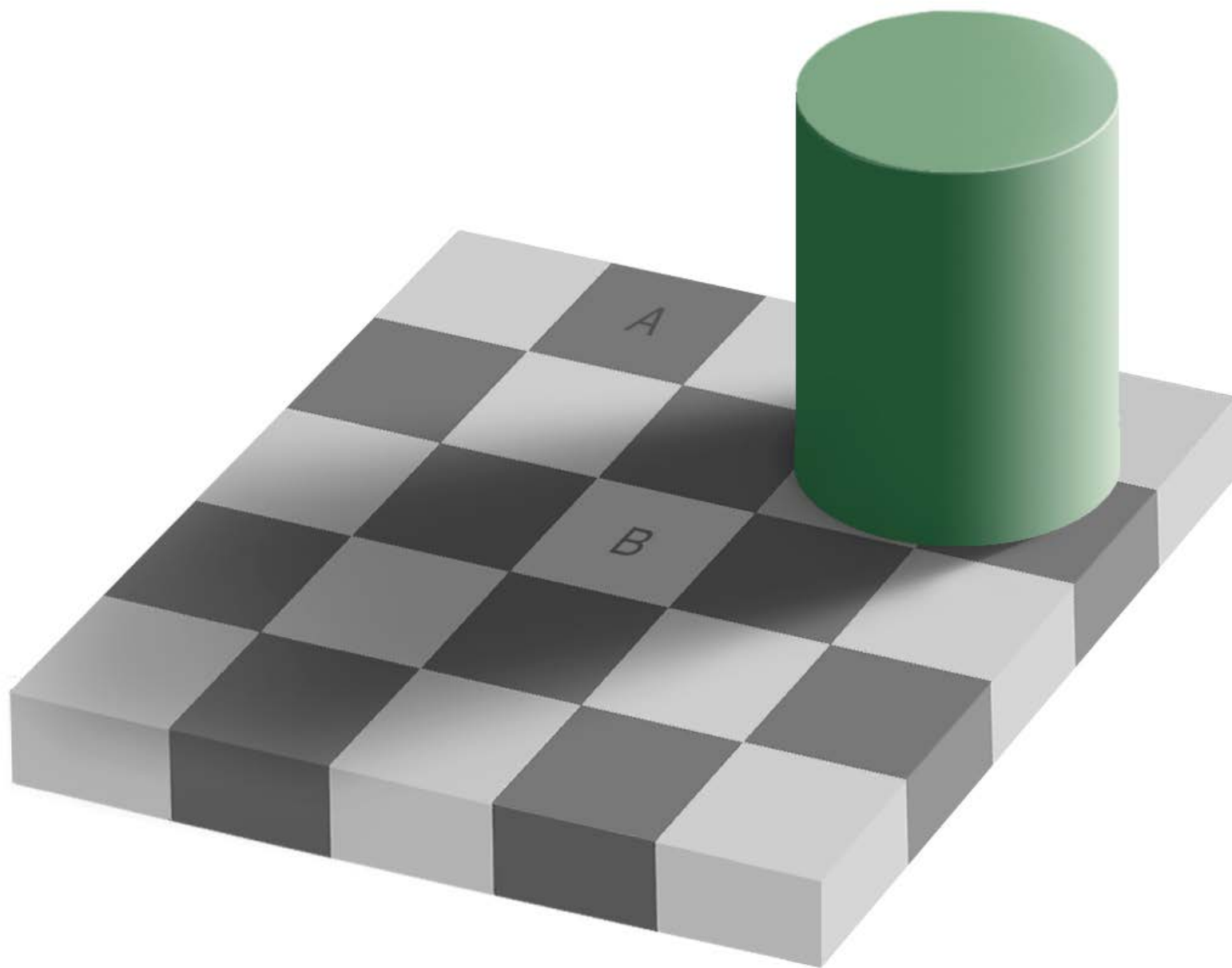
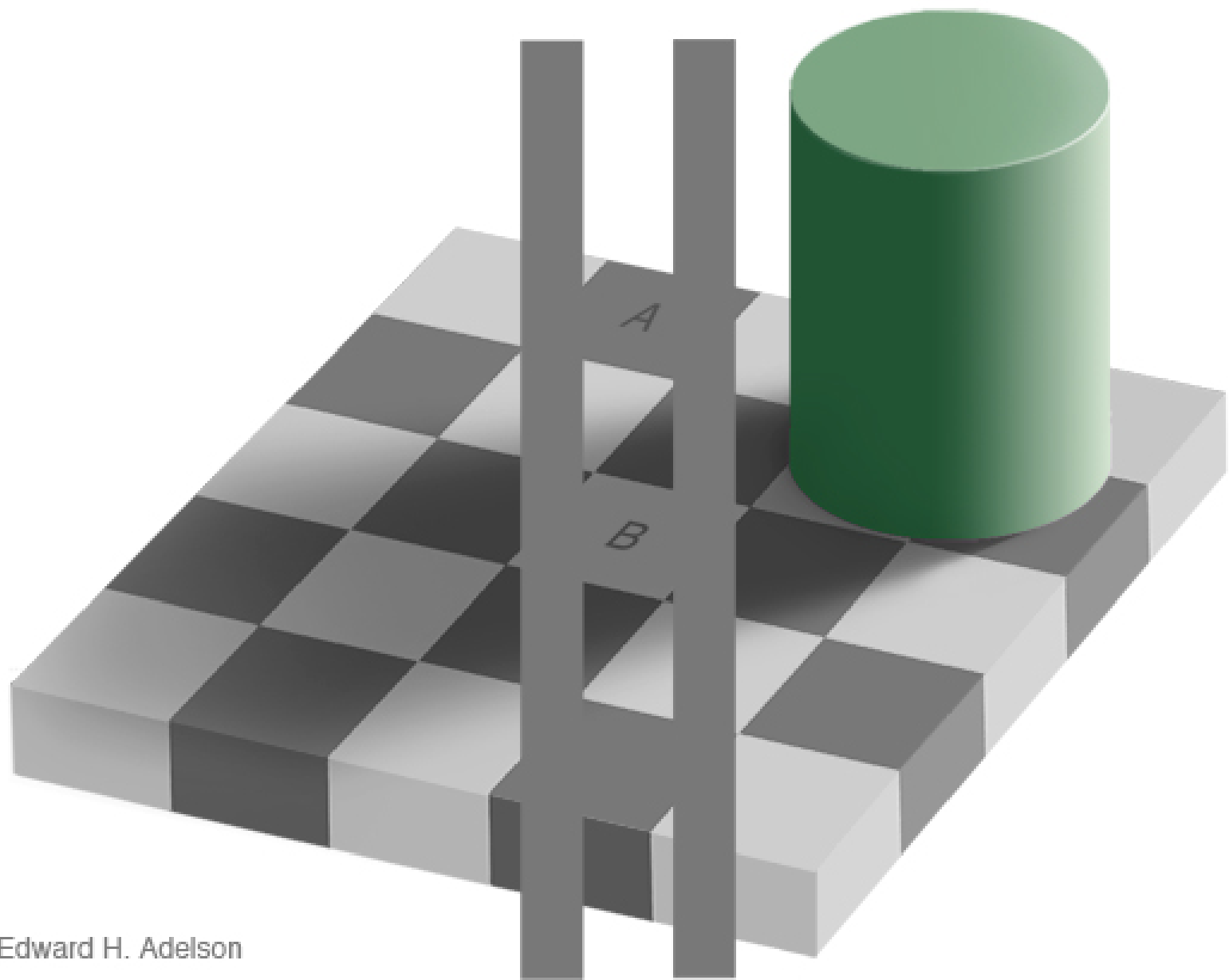


Image from Adelson, MIT

# POP QUIZ, HOTSHOT

- 1) A IS LIGHTER THAN B
- 2) B IS LIGHTER THAN A
- 3) A AND B ARE THE SAME
- 4) JUST TELL ME, ALLRIGHT?



Edward H. Adelson

Image from Adelson, MIT



**1** | **PHYSIOLOGY**

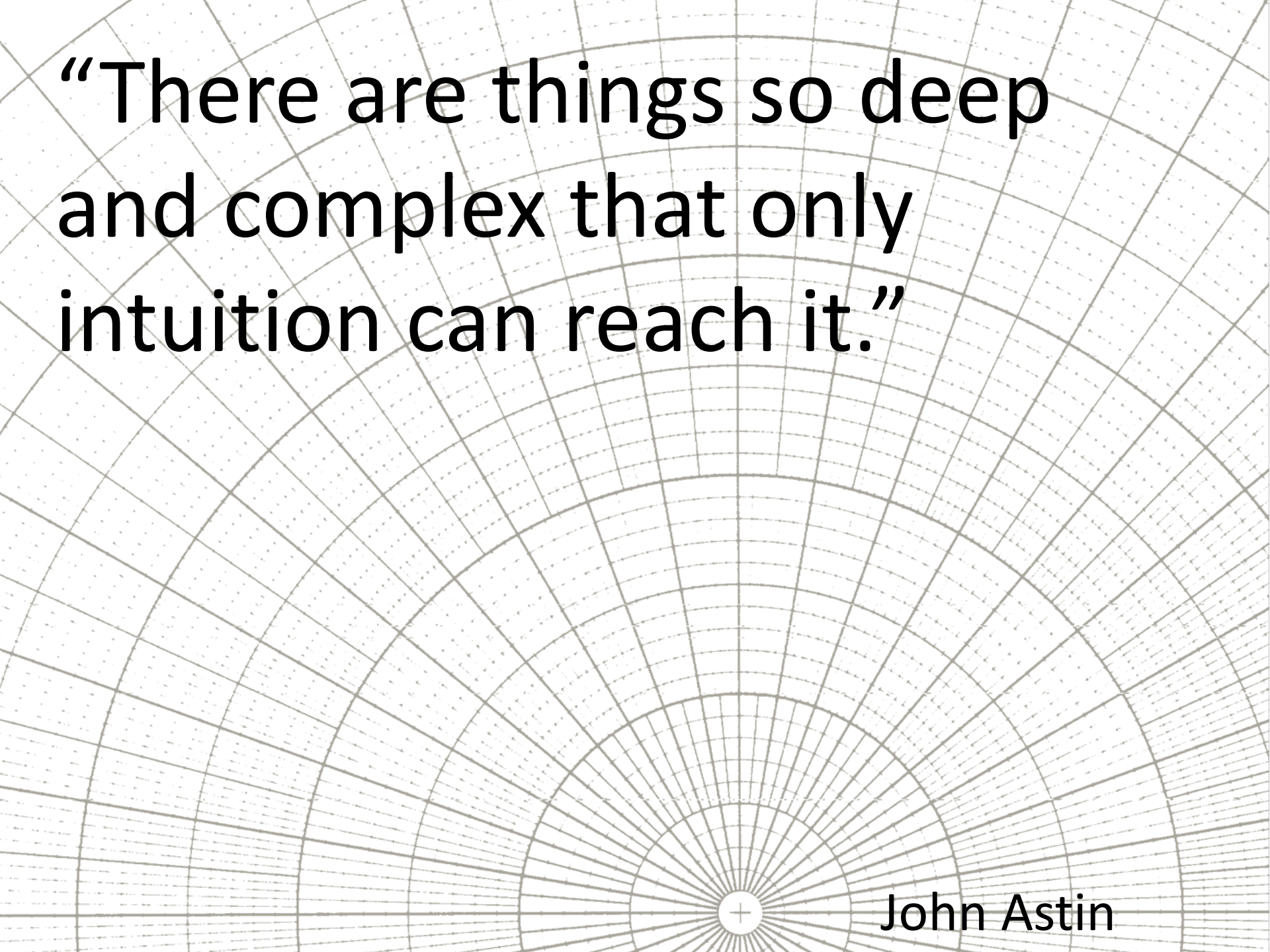
**2** | **PSYCHOLOGY**

**3** | **PERCEPTION**

**4** | **COLOR**

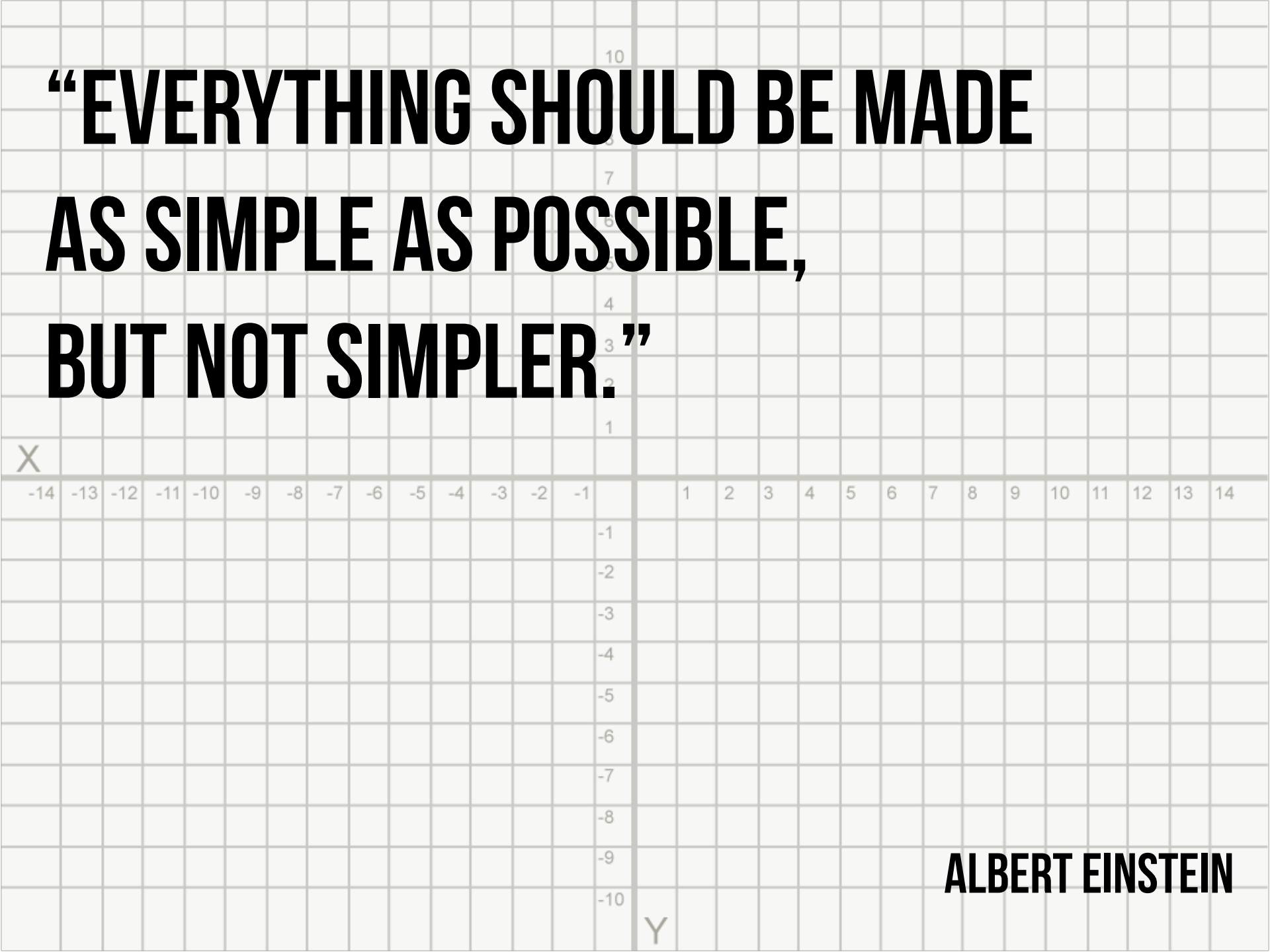
**IF SEEING IS BELIEVING...**  
**HOW DO I SEE?**





“There are things so deep  
and complex that only  
intuition can reach it.”

John Astin



**“EVERYTHING SHOULD BE MADE  
AS SIMPLE AS POSSIBLE,  
BUT NOT SIMPLER.”**

**ALBERT EINSTEIN**



