

(9회) 1월 생물학소모임

# Cutting-Edge of Neurobiology

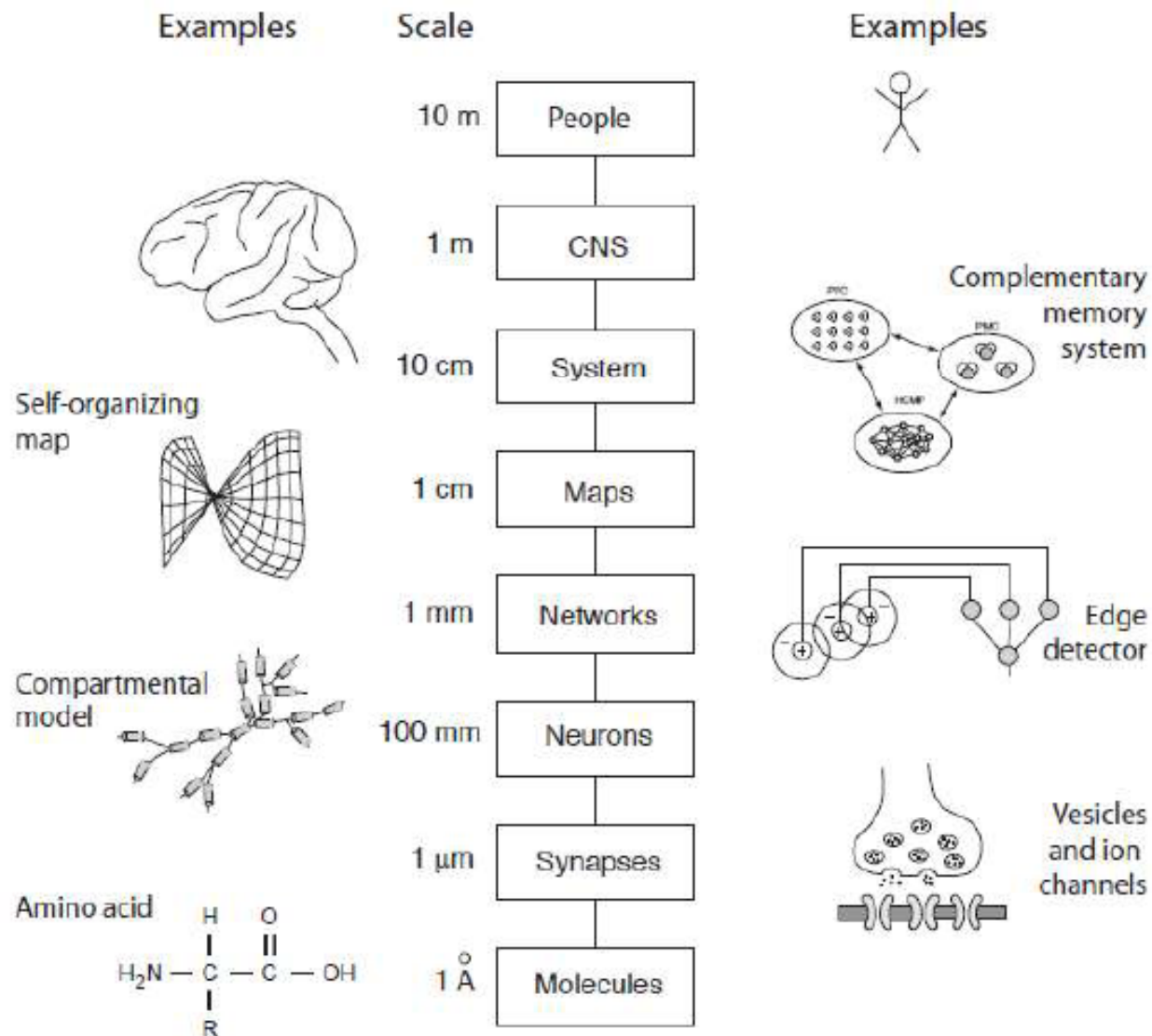
: 신경생물학 최신지견, 입문 & OT

2012년 1월 29일  
정독도서관  
발표: 한정규

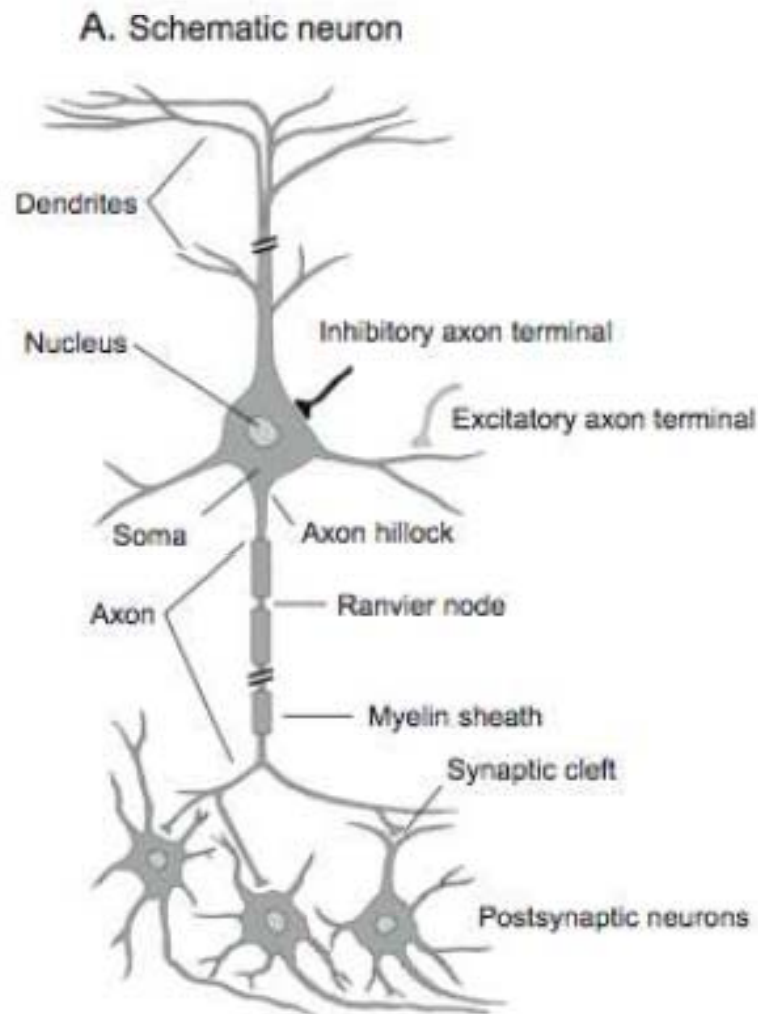
# Outline

- 신경생물학이란?
- 최근에 각광받는 이슈들
- 본 모임의 계획
- Q&A

# 신경생물학이란



# 신경세포 Neuron



B. Pyramidal cell



C. Granule cell

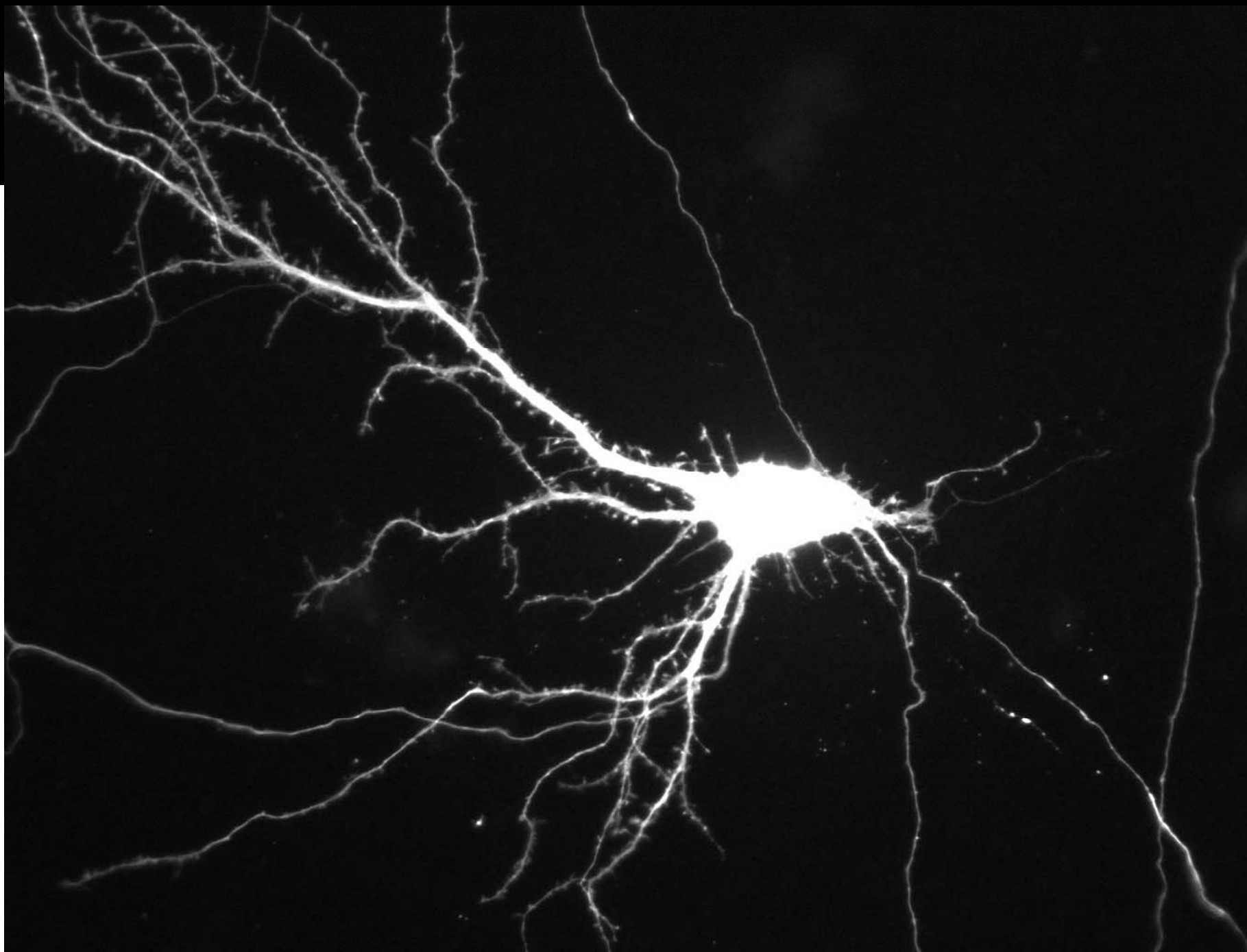


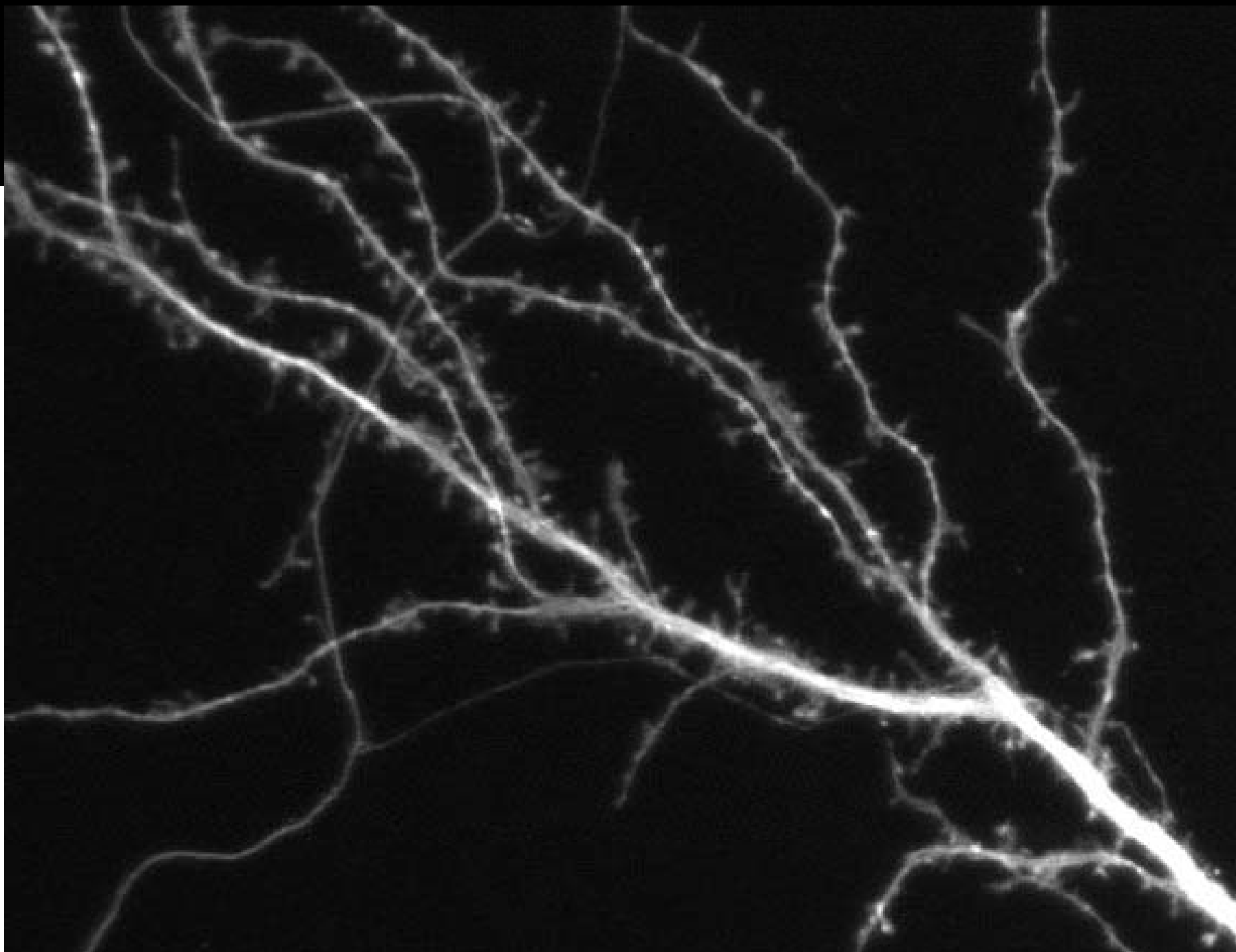
E. Purkinje cell

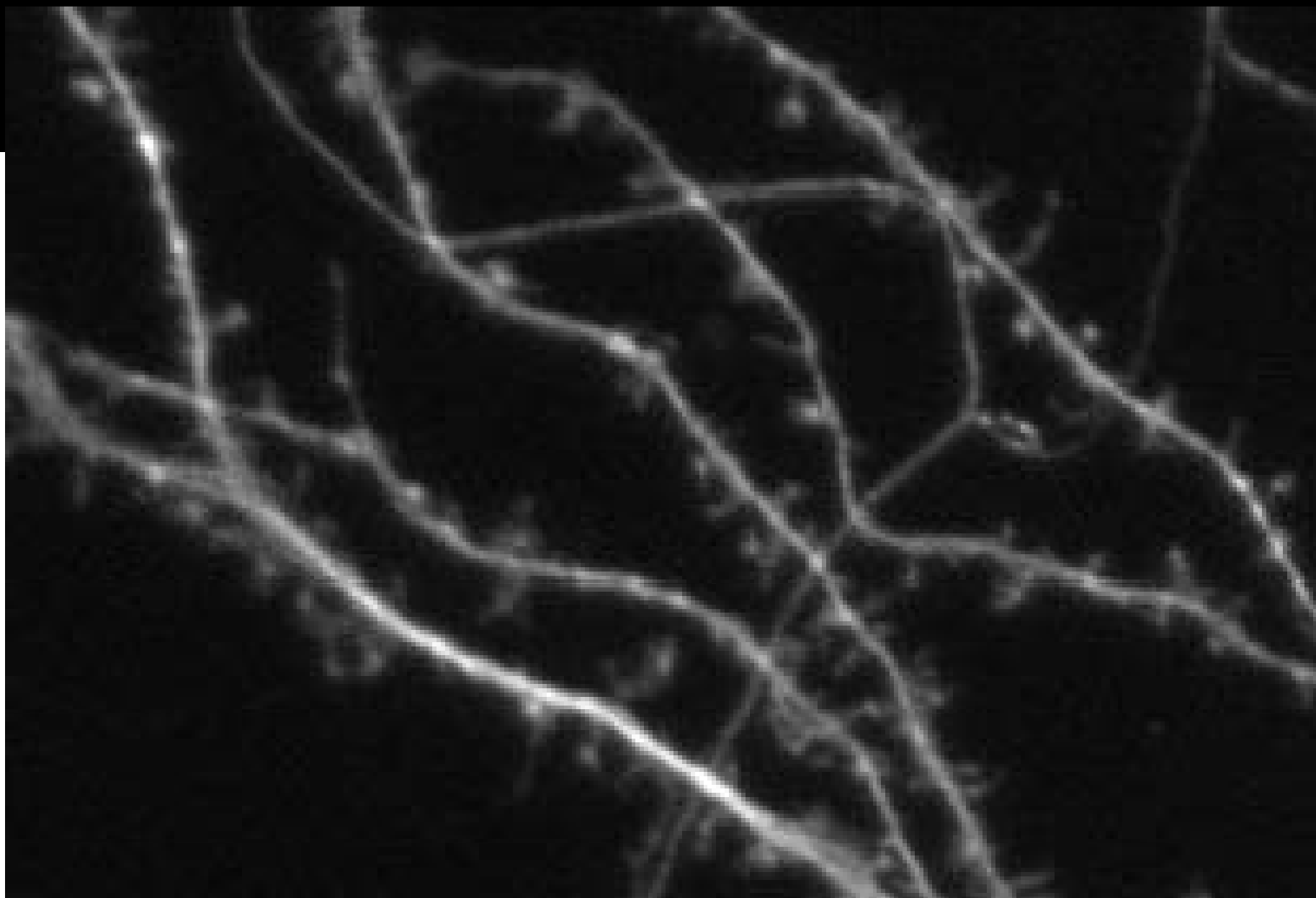


D. Spiny cell



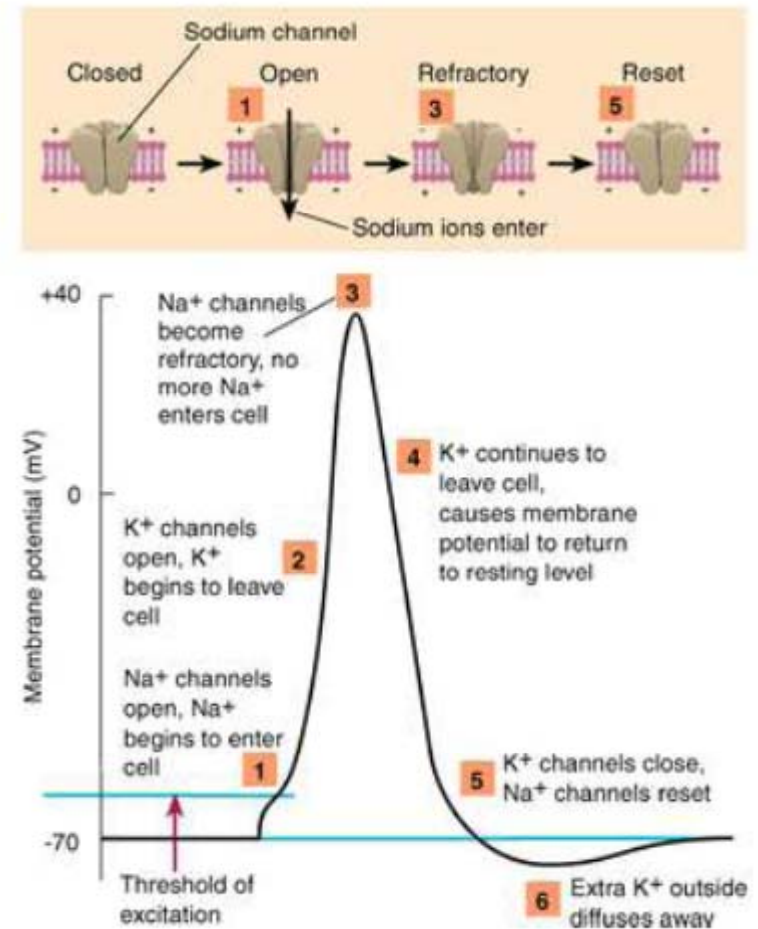
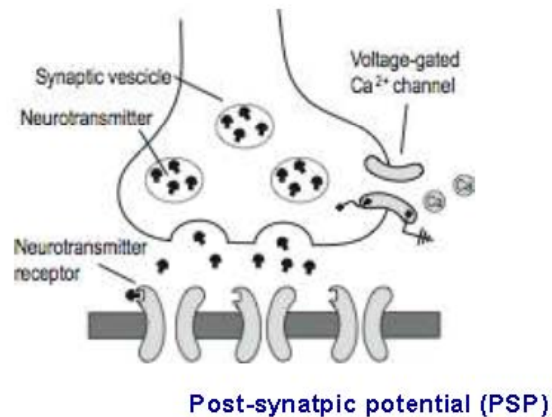
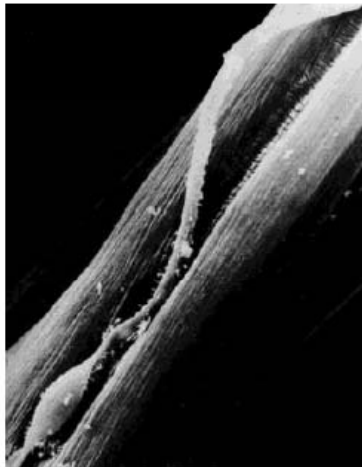






# 신경세포에 숨겨진 이야기...

Motor Endplate  
(Frog muscle)

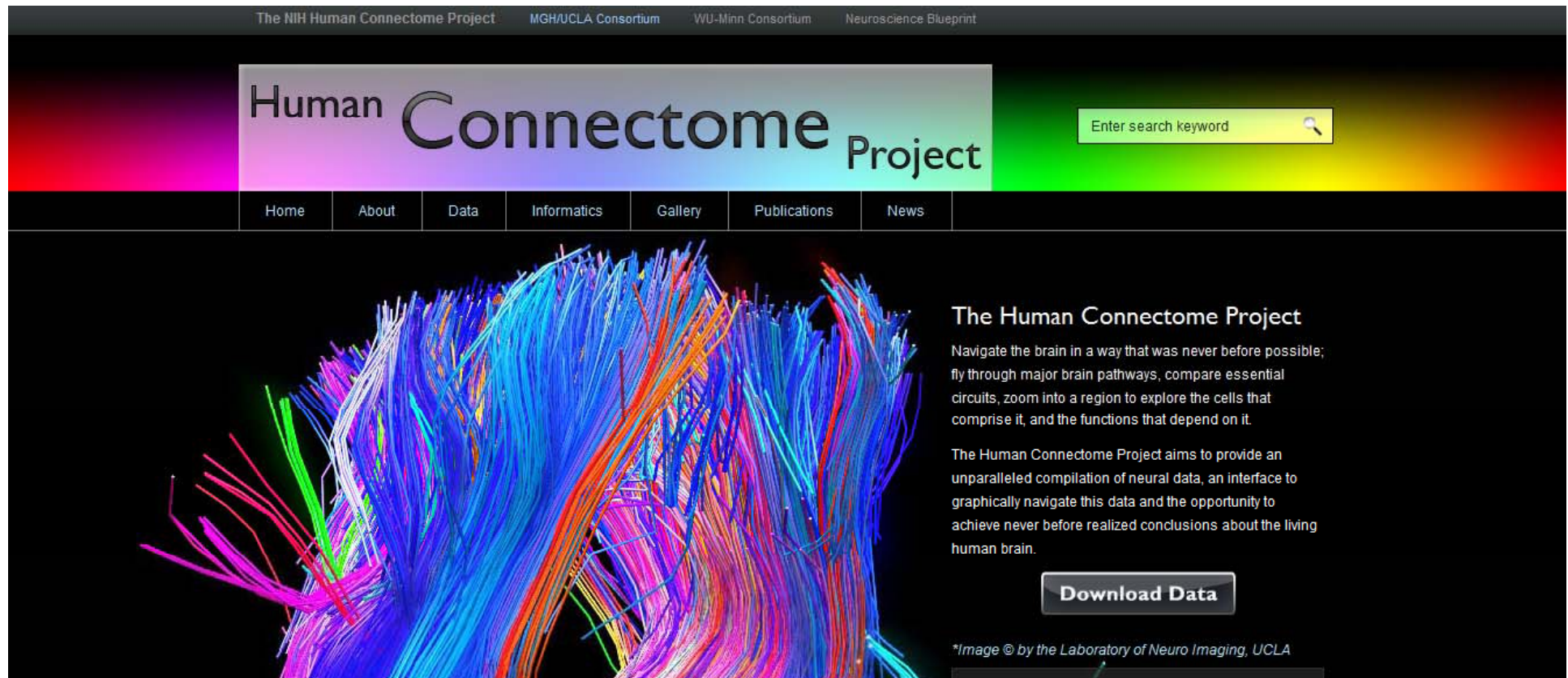




# 최근 이슈들

- Connectomics
- Synapse dynamics/morphology
- Neuroimmunology
  
- Optogenetics
- Advance in Microscopy

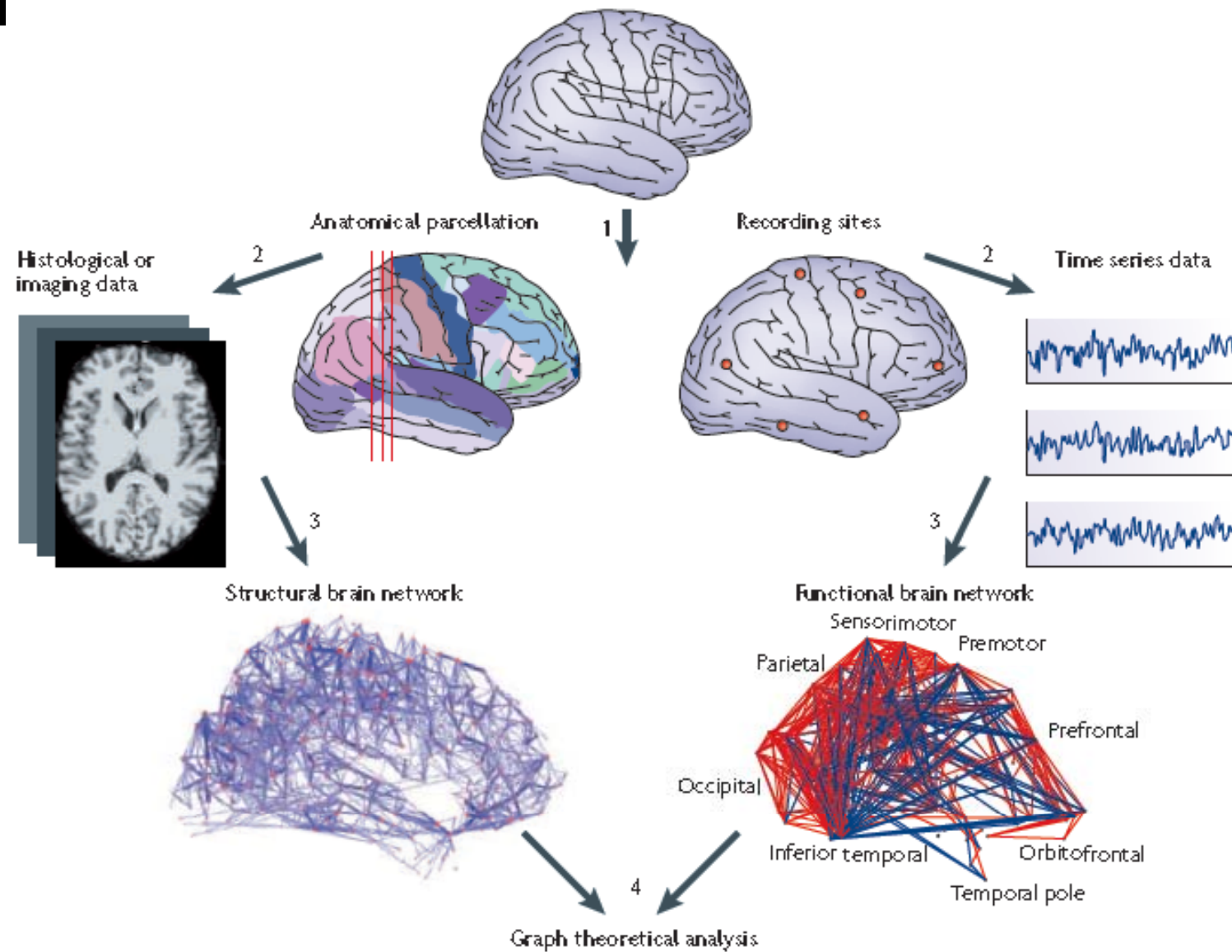
# Connectomics



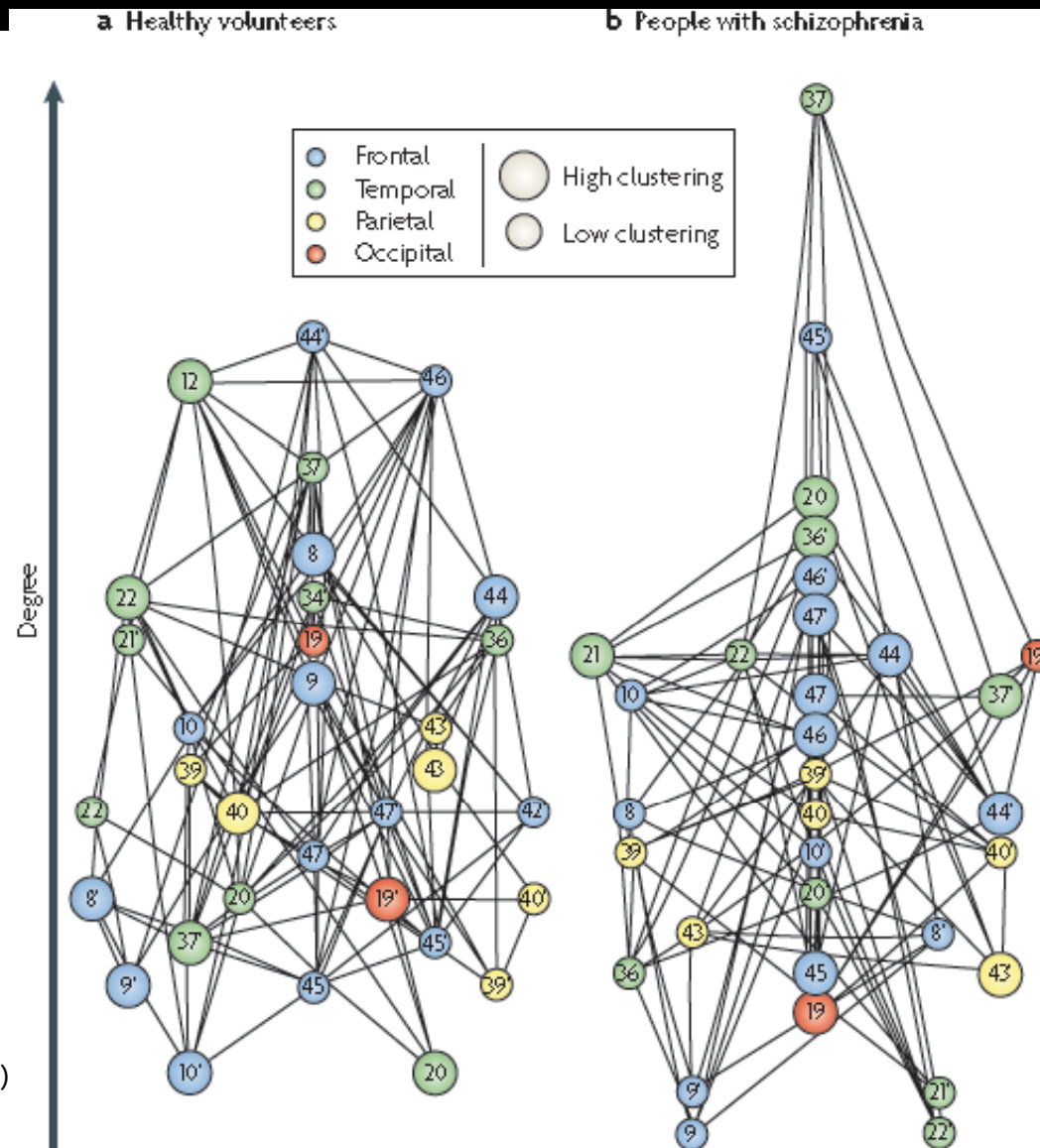
<http://www.humanconnectomeproject.org/>

# Connectomics

- Structural/anatomical (connection):  
two regions are connected by a fibre tract
- Functional (correlation):  
two regions are active at the same time
- Effective (causation):  
region A modulates activity in region B

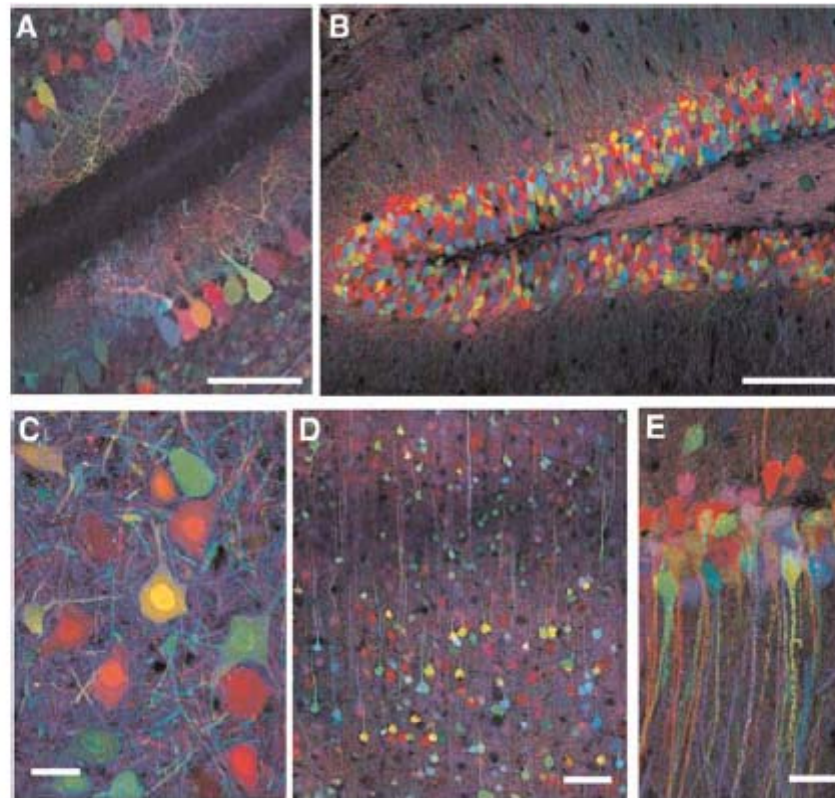


# Connectomics





# Connectomics



**FIGURE 2.** Mosaic expression of fluorescent proteins in Brainbow mice. (A,B,D,E) *Thy1.2-Brainbow-1.0* line L; (C) line H. Combinatorial expression of FPs is observed throughout the brain. (A) Purkinje neurons of cerebellum; (B) dentate gyrus of the hippocampus; (C) brain stem; (D) cortex (layers 3–5); (E) hippocampus CA1. Scale bars, 125  $\mu\text{m}$  (A); 150  $\mu\text{m}$  (B); 40  $\mu\text{m}$  (C); 100  $\mu\text{m}$  (D); 40  $\mu\text{m}$  (E).

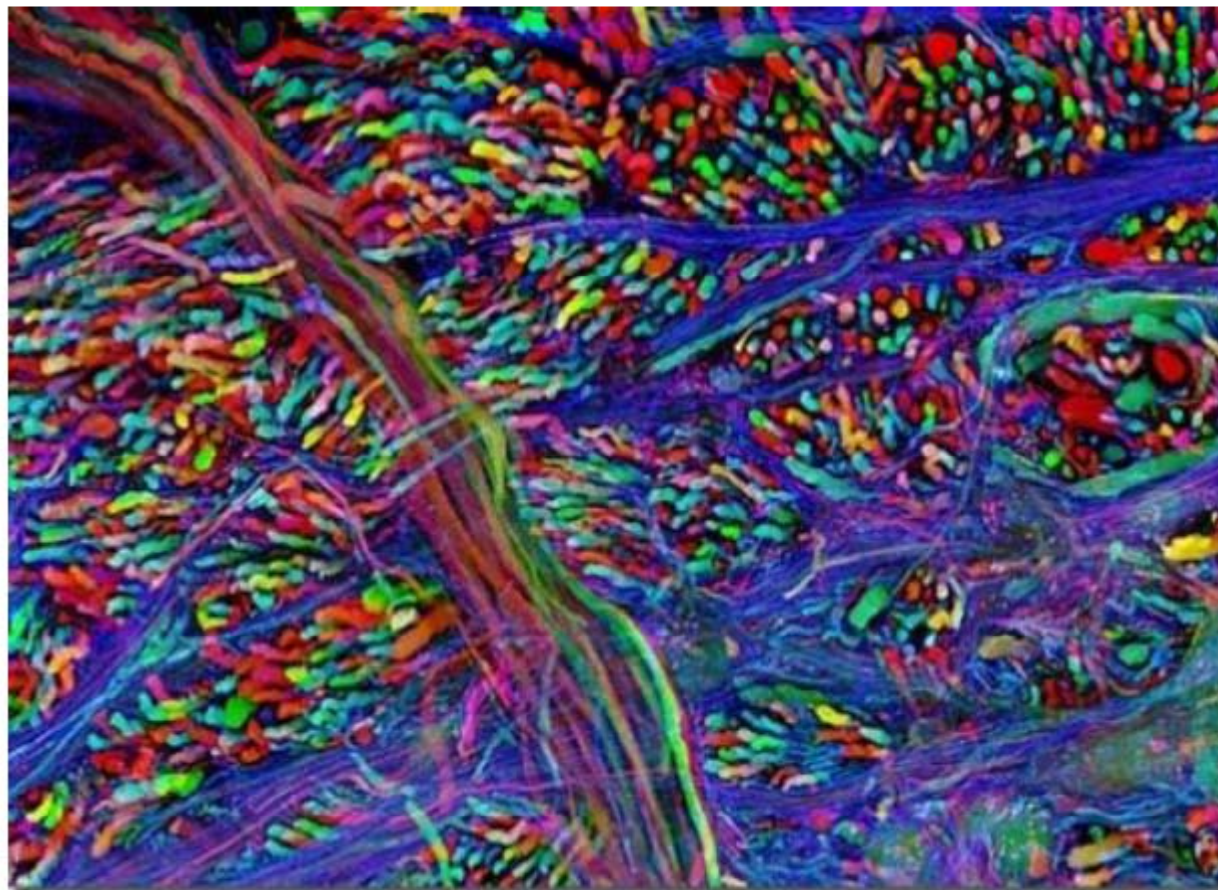
“Brainbow”

Jeff Lichtman at Harvard



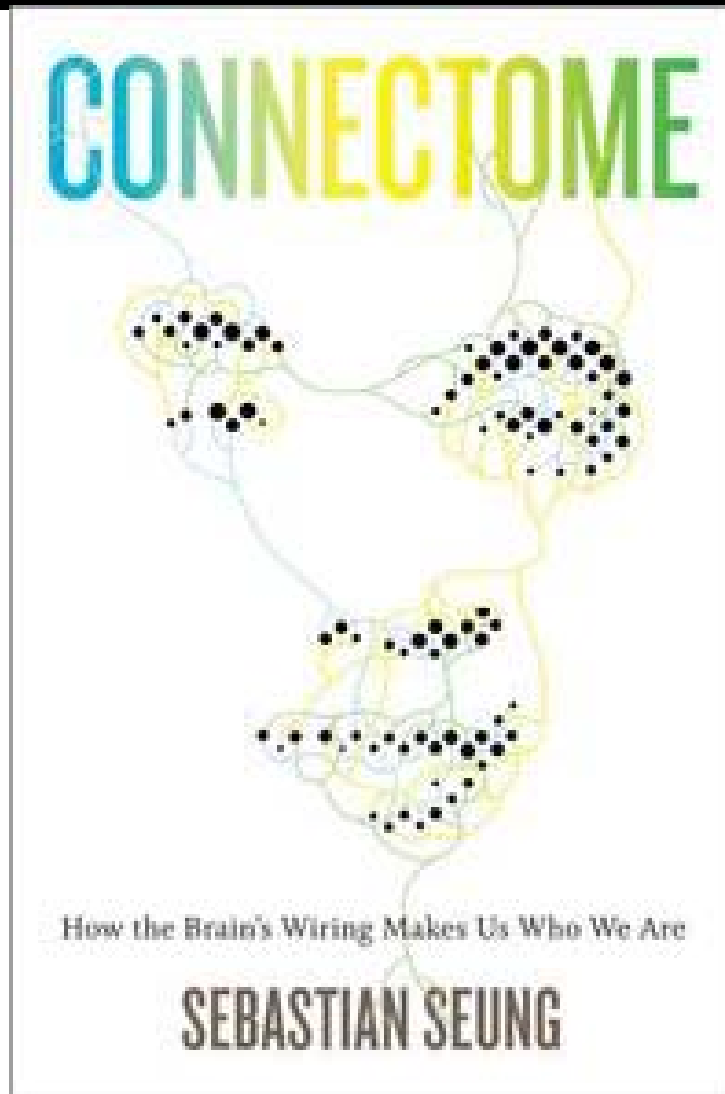
# Connectomics

## Brainbow mice

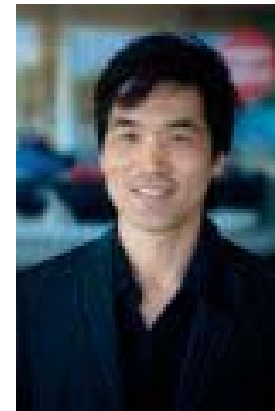


by Jean Livet

# Connectomics

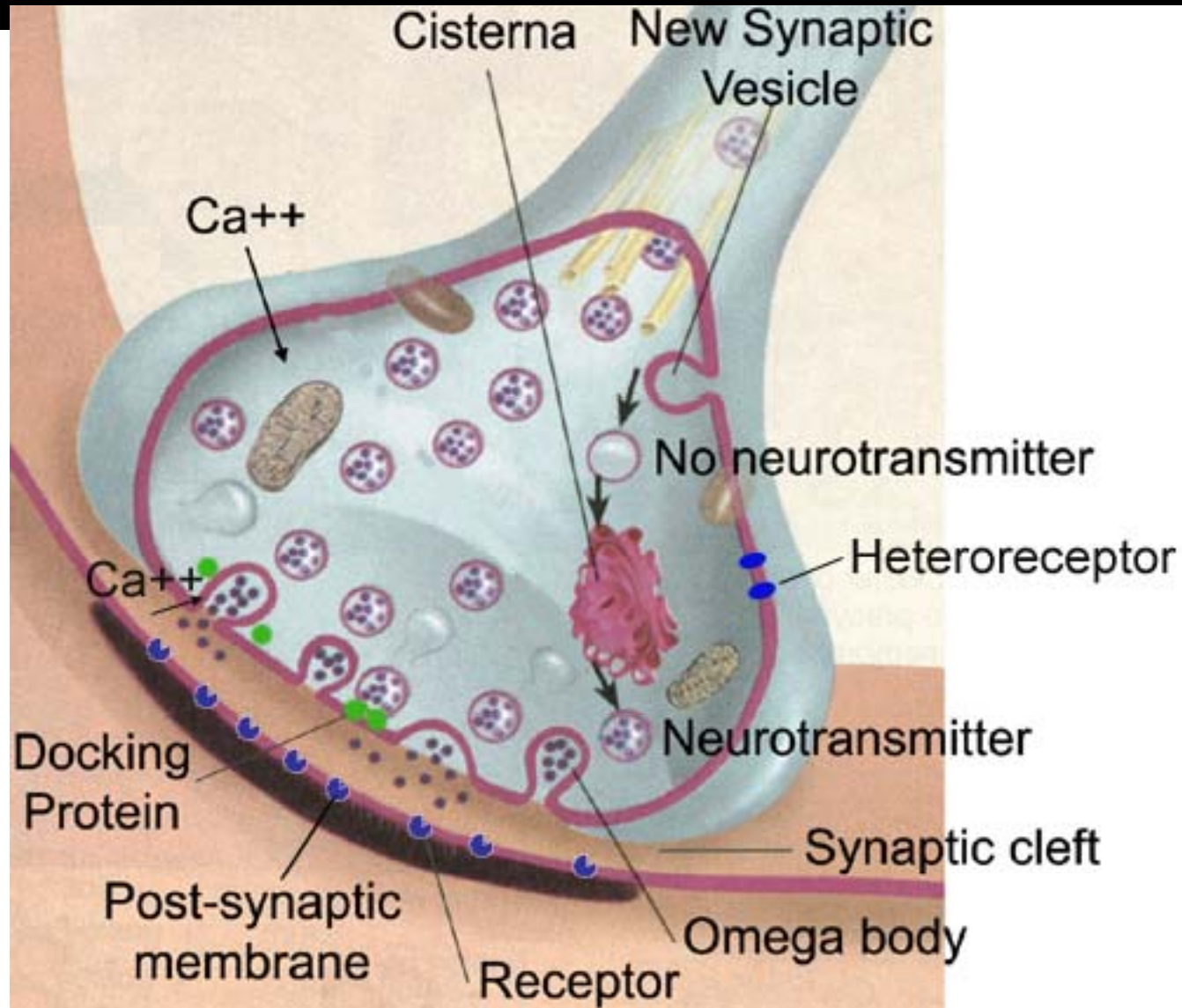


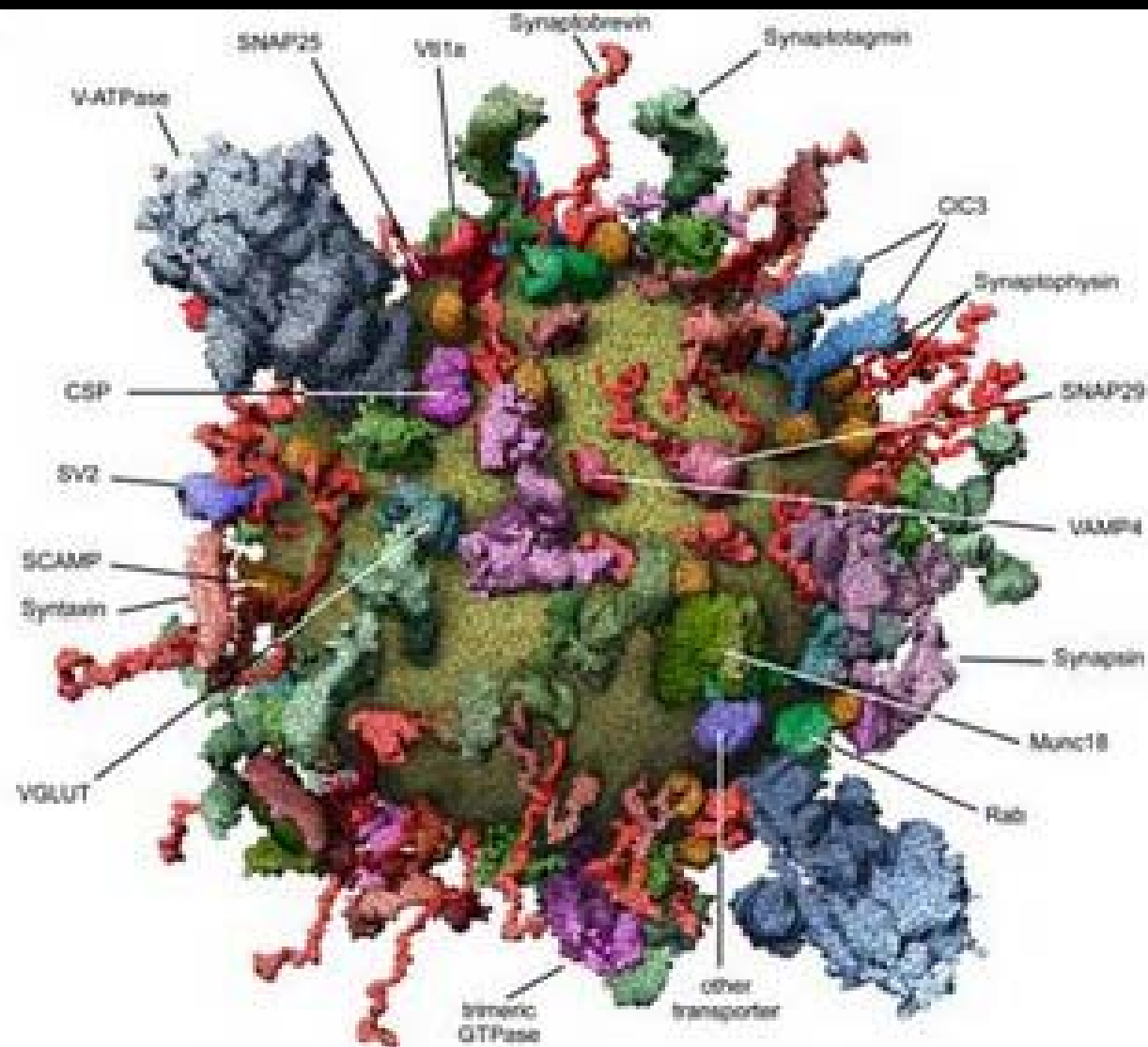
- Connectome
- Sebastian Seung :  
Professor of Computational  
Neuroscience and Physics at the  
Massachusetts Institute of  
Technology



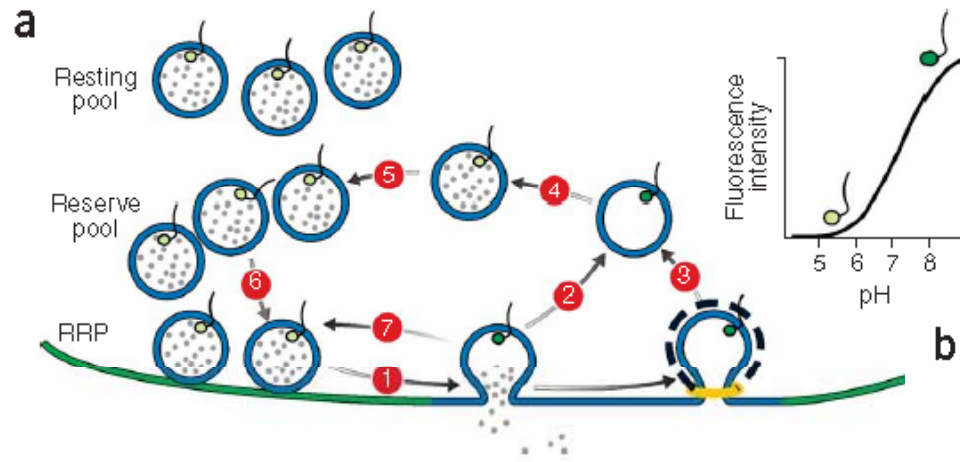


# Synapse

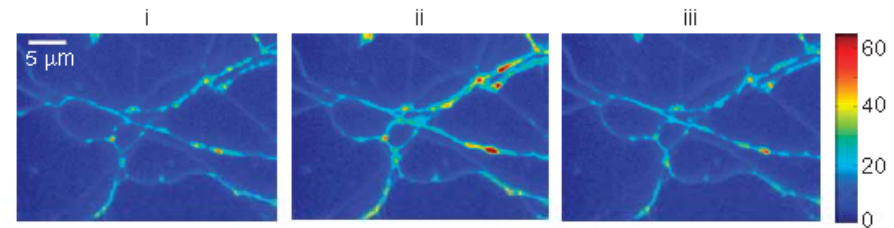




# Synapse dynamics

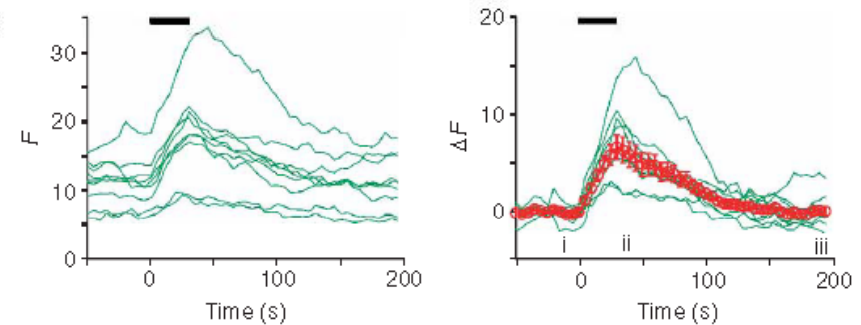
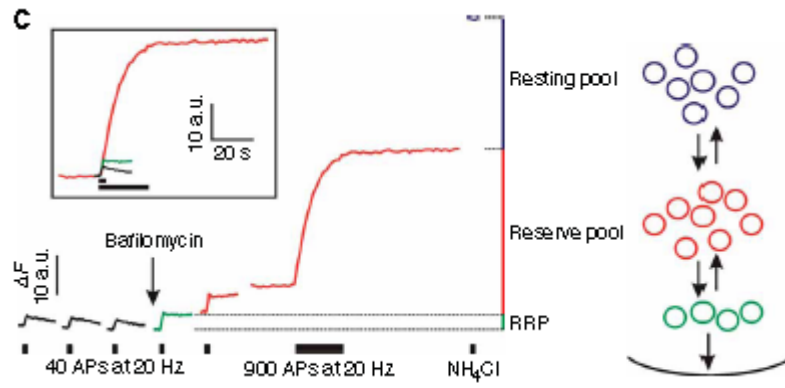


**b**

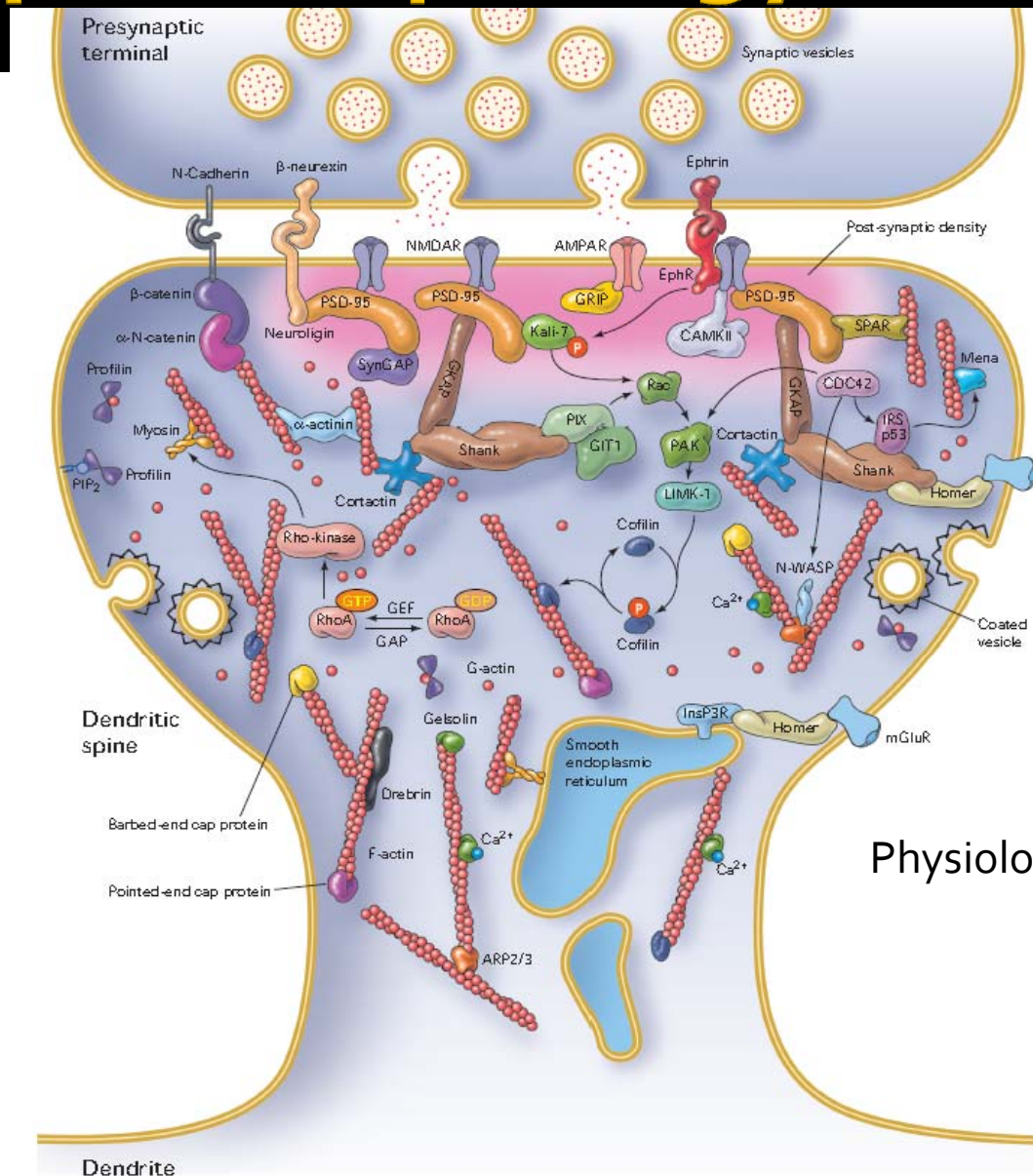


Rest  $\rightarrow$  1  $\rightarrow$  Stim  $\rightarrow$  2,3  $\rightarrow$  4  $\rightarrow$  Recovery

**c**



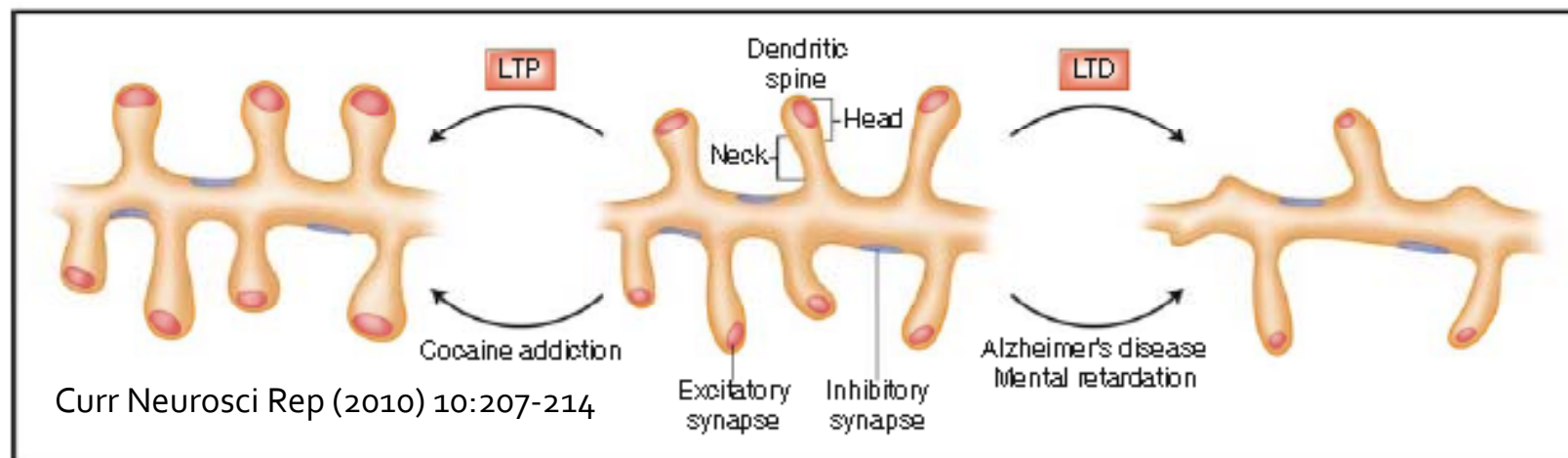
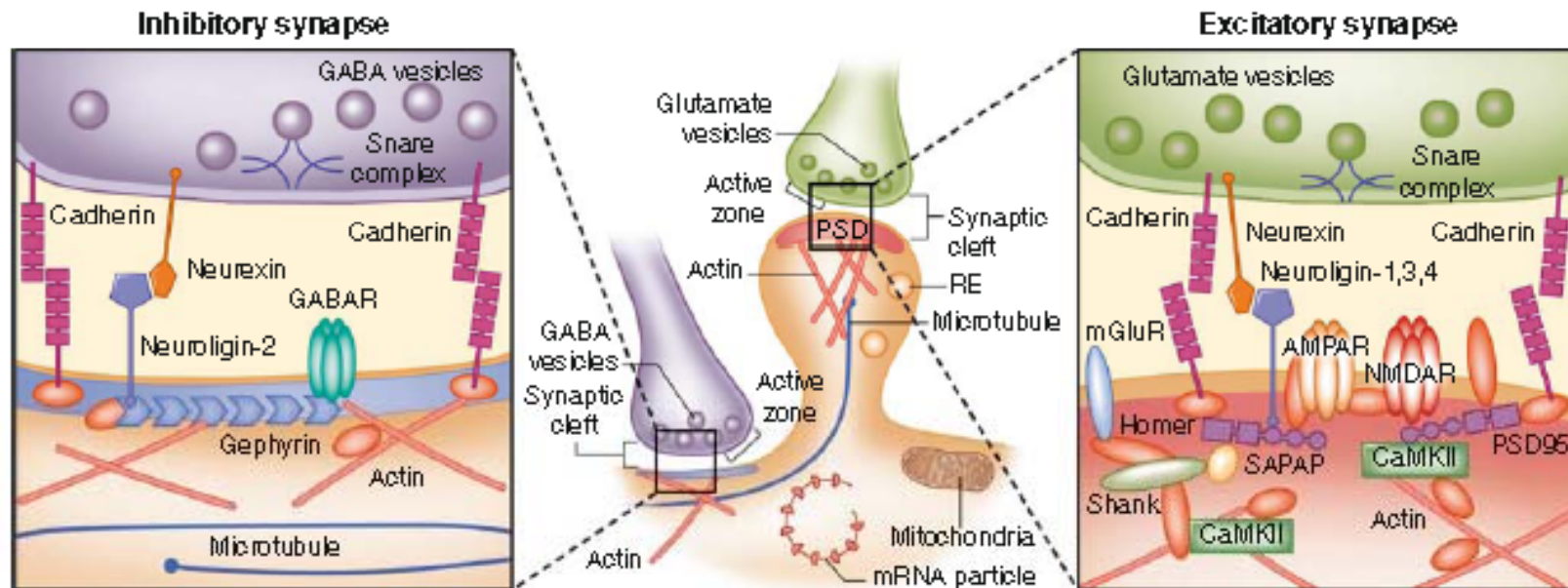
# Synapse morphology



Physiology 21:38-47 2006



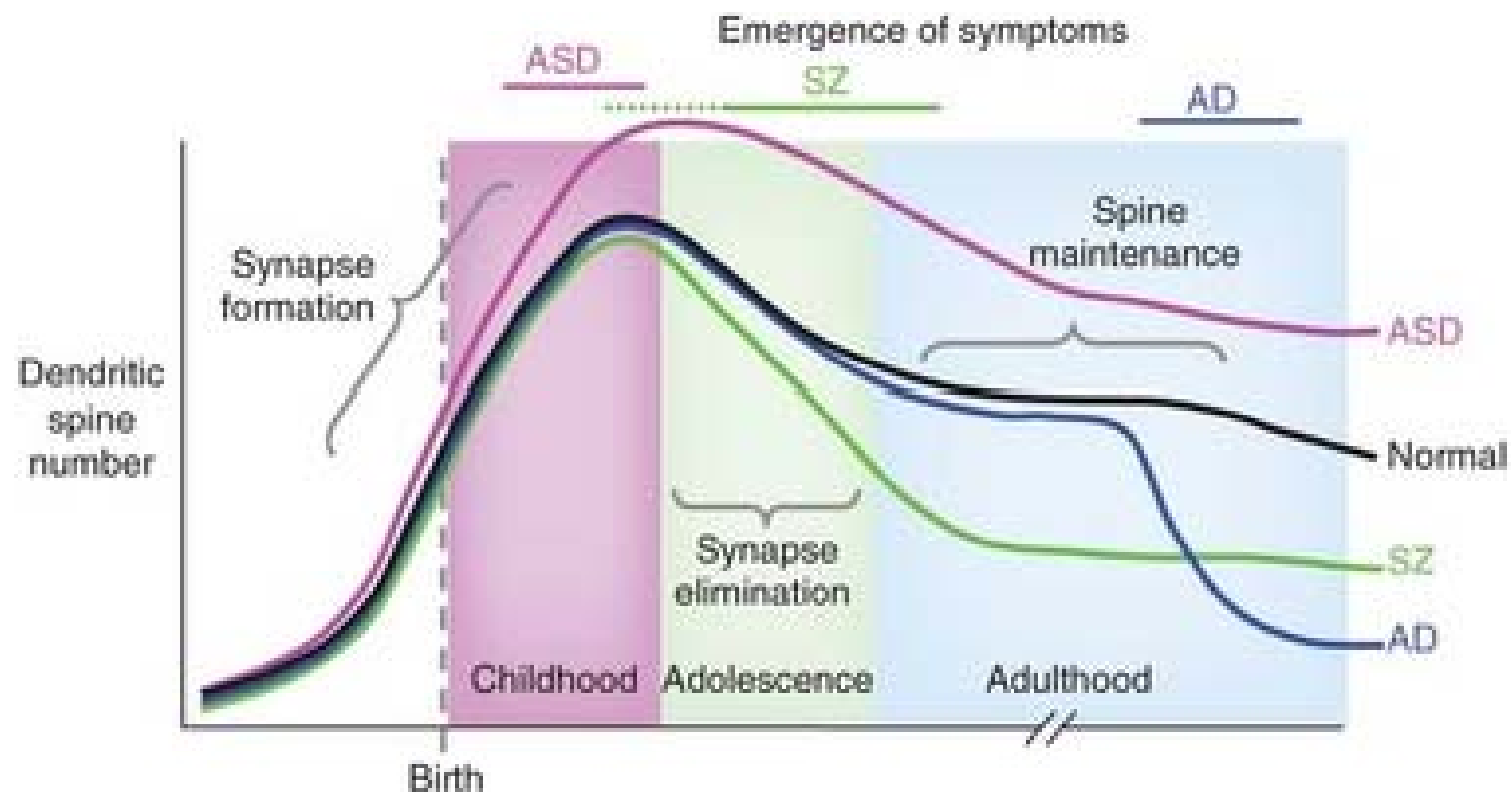
# Synapse morphology



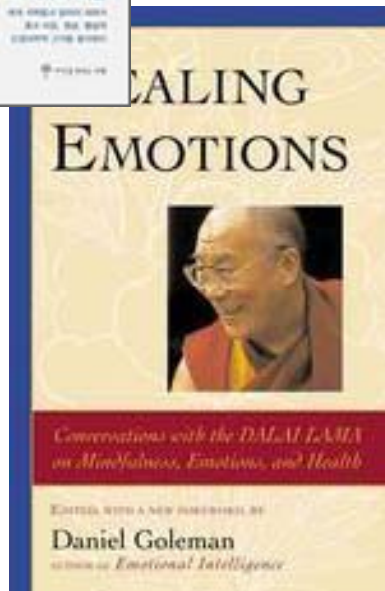
Curr Neurosci Rep (2010) 10:207-214

# Synapse morphology

- Dendritic spine pathology in neuropsychiatric disorders

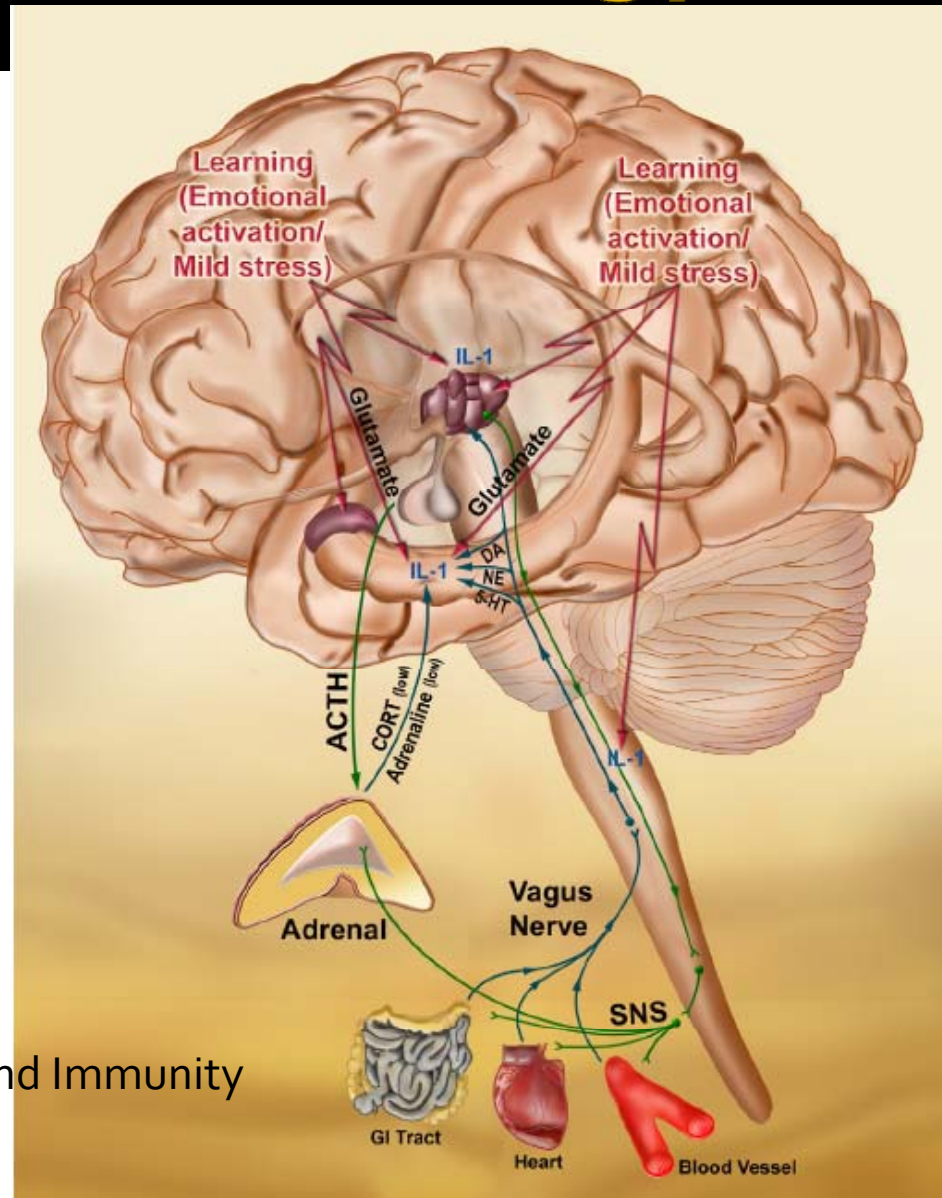


# Neuroimmunology



- 1부 몸의 윤리학—몸이 인류의 보편적 윤리 기반이 될 수 있는가
  1. 미덕에 관한 세 가지 견해
  2. 고통을 주는 감정과 기운을 돋우는 감정: 건강에 미치는 영향
- 2부 생물학적 근거—마음이 몸을 치유한다
  3. 몸의 자아
  4. 두뇌와 감정
  5. 스트레스, 트라우마, 몸
- 3부 의학과 효과적인 방법—현대 과학으로 정념의 효과를 밝힌다
  6. 의술로서의 정념
  7. 행동의학
- 4부 감정과 문화: 동서양의 비교—동양문화와 서양문화는 감정을 어떻게 바라보는가
  8. 기독교와 불교전통에서의 미덕
  9. 자존감의 뿌리: 동서양의 차이
- 5부 의식의 본질—두뇌로부터 독립된 의식은 존재할 수 있는가
  10. 마음, 두뇌, 몸
  11. 미묘한 의식
- 6부 보편적인 윤리—자비와 애정이 인류 보편의 윤리기반이다
  12. 의술과 자비

# Neuroimmunology

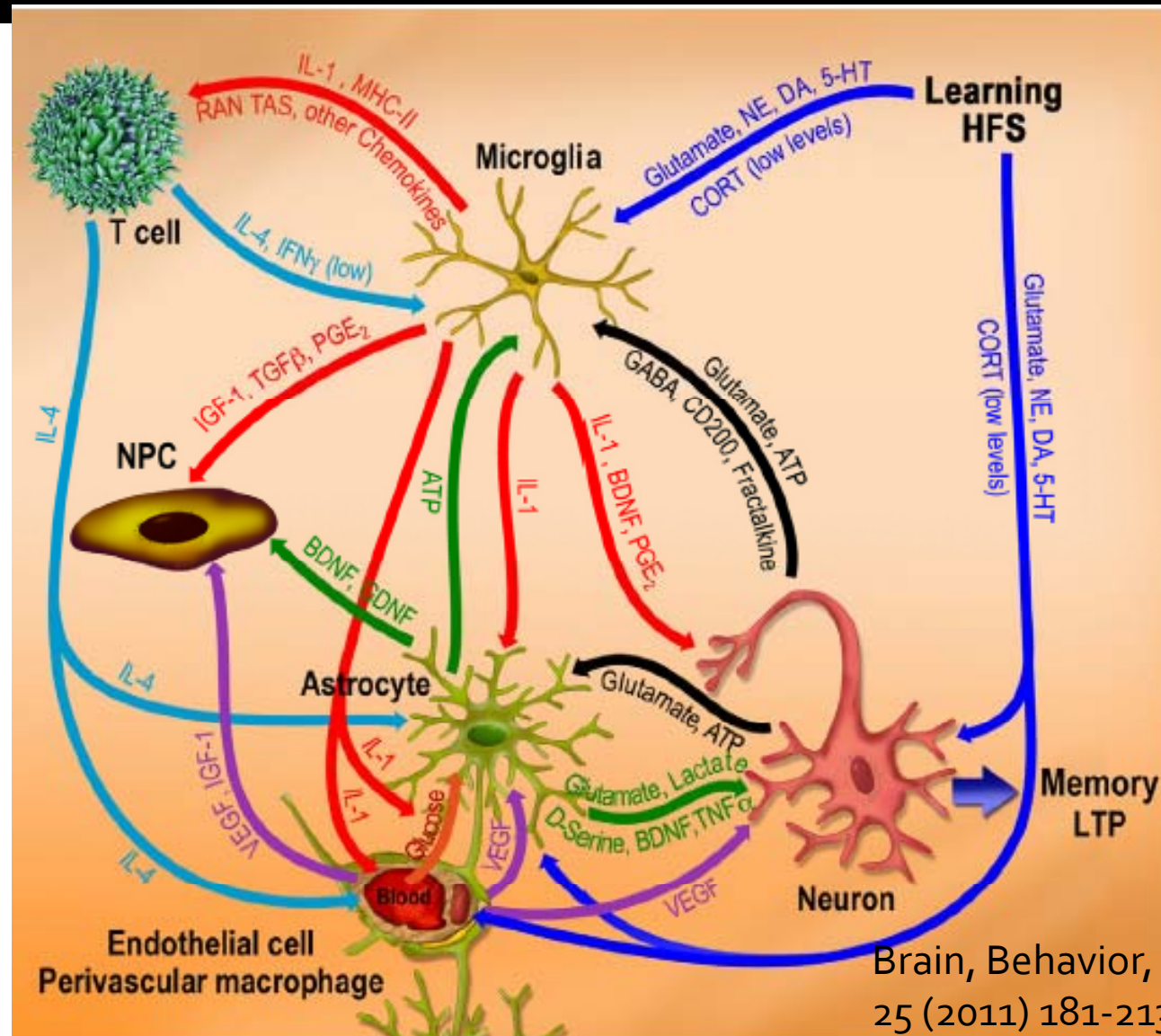


긍정적인 기능

Brain, Behavior, and Immunity  
25 (2011) 181-213

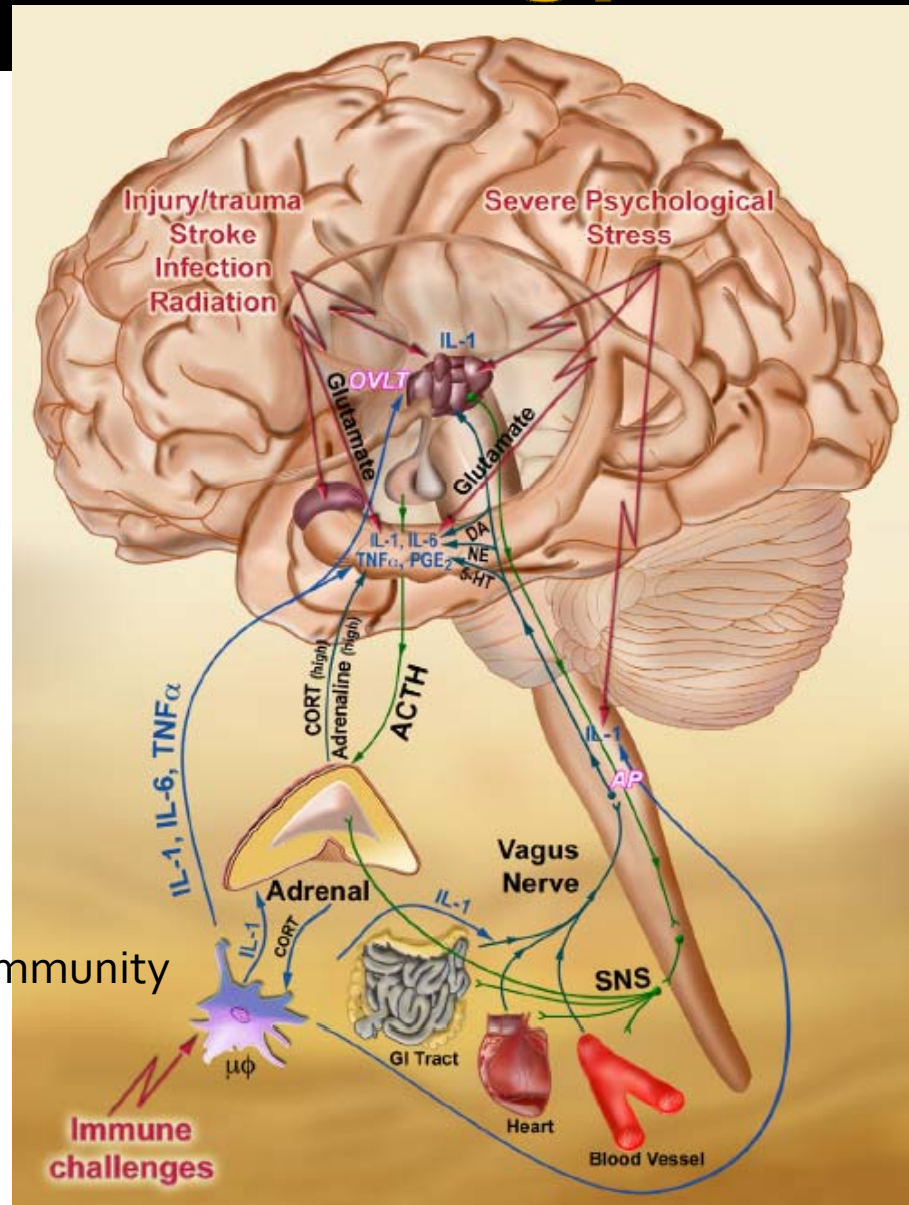


# Neuroimmunology



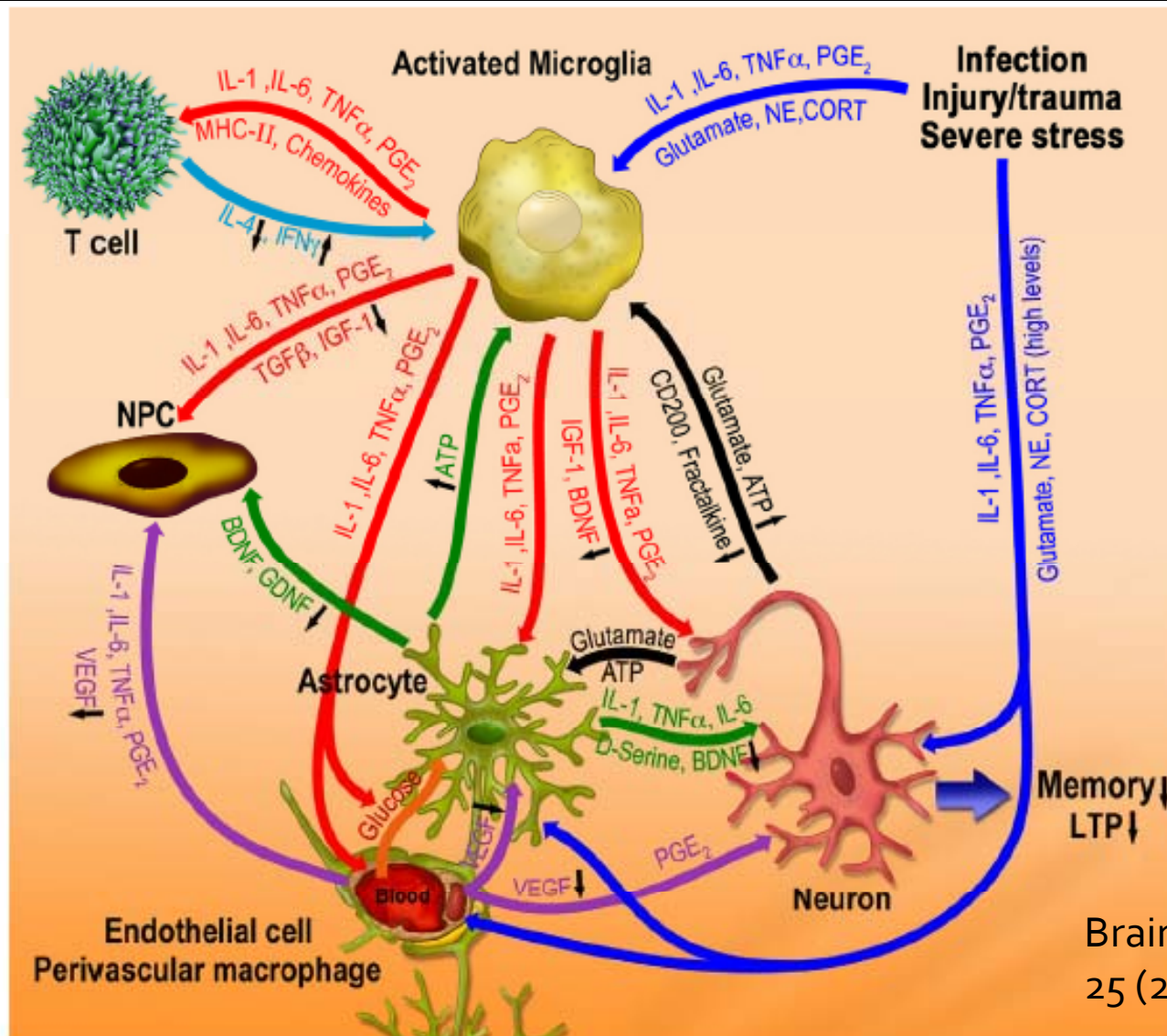
Brain, Behavior, and Immunity  
25 (2011) 181-213

Brain, Behavior, and Immunity  
25 (2011) 181-213



부정적인 기능

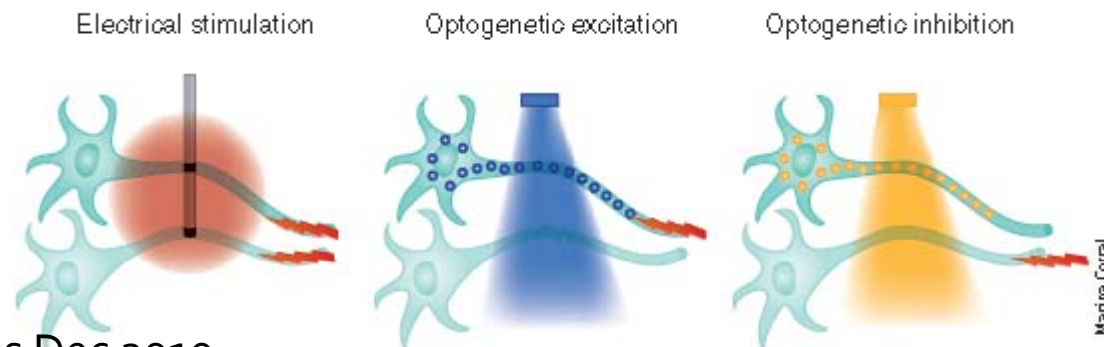
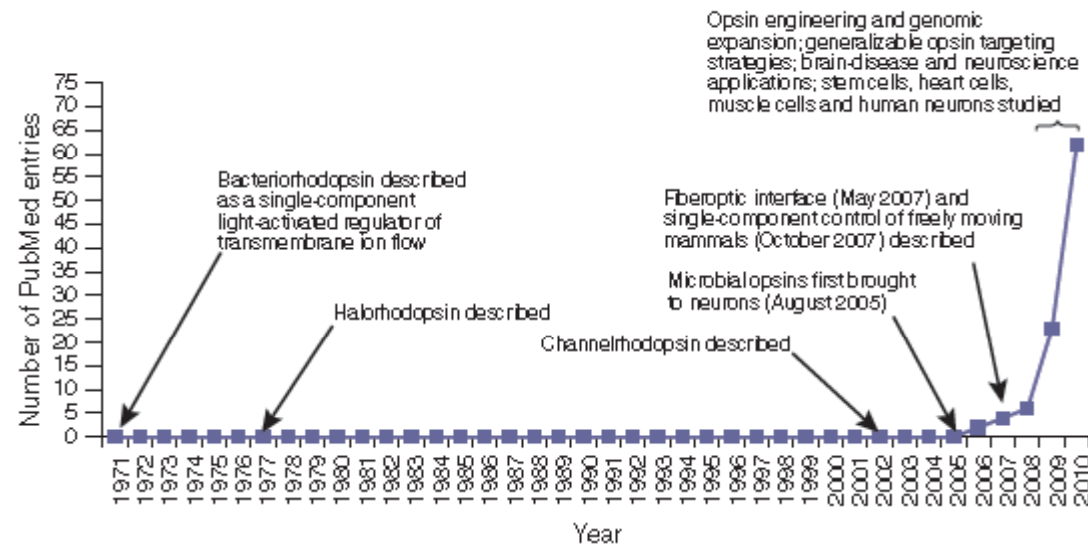
# Neuroimmunology



Brain, Behavior, and Immunity  
25 (2011) 181-213

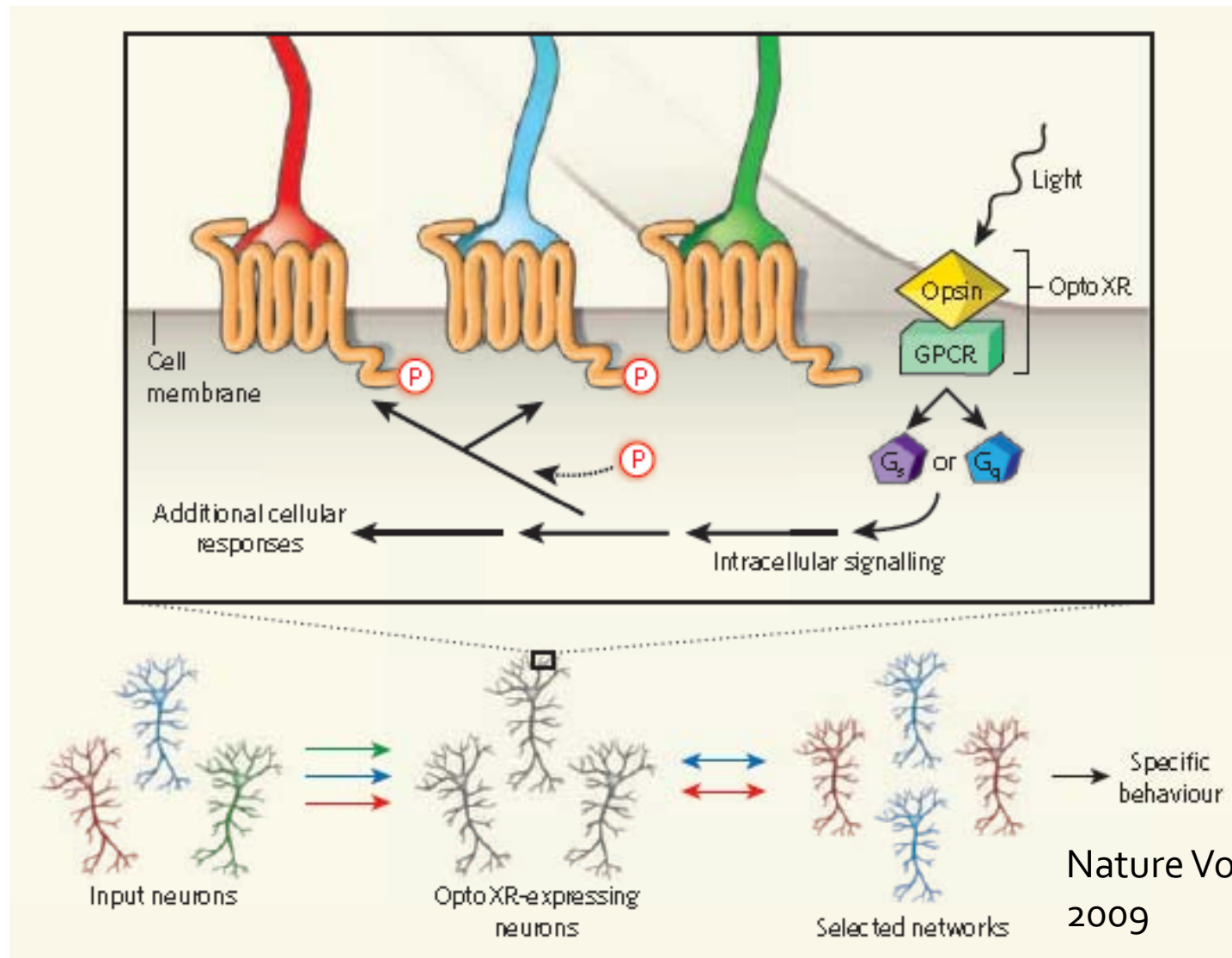


# Optogenetics



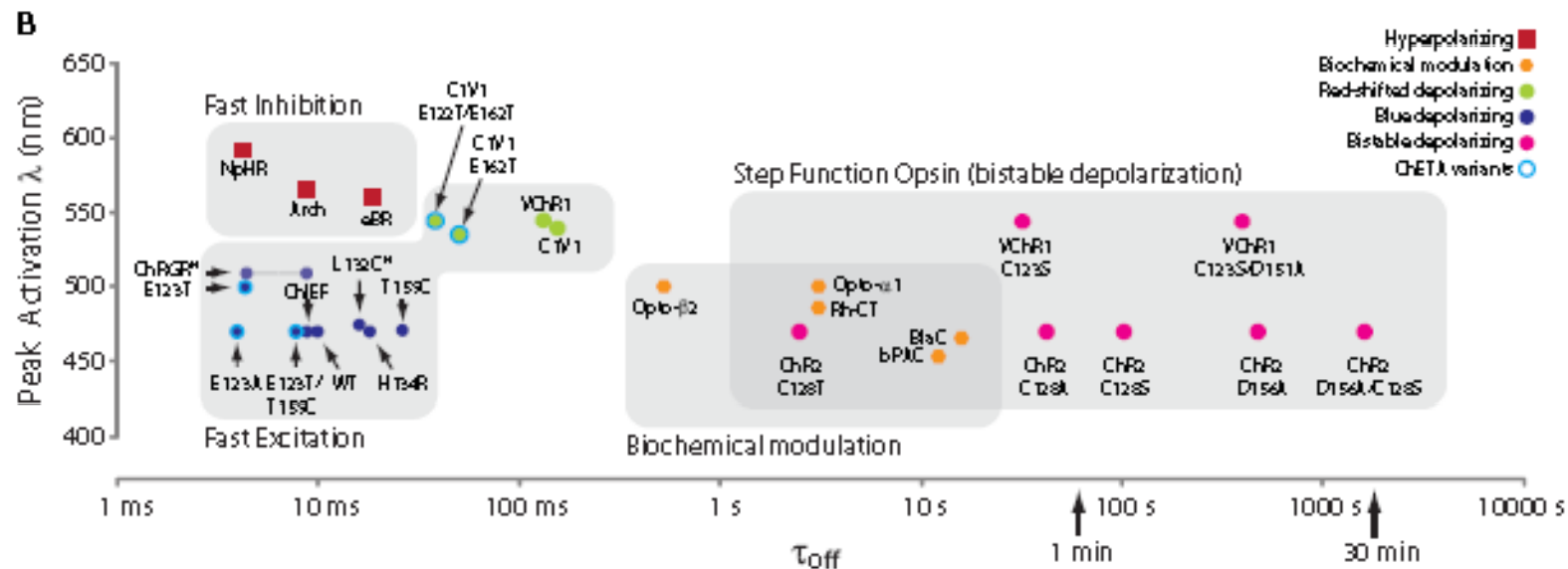
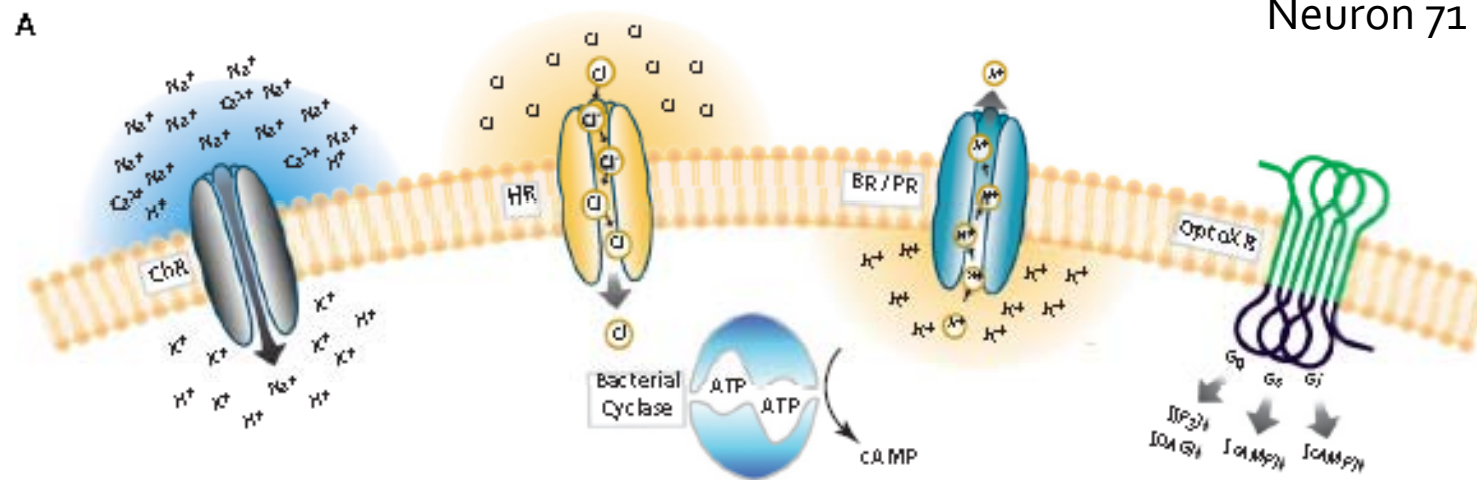
Nature Methods Dec 2010

# Optogenetics



# Optogenetics

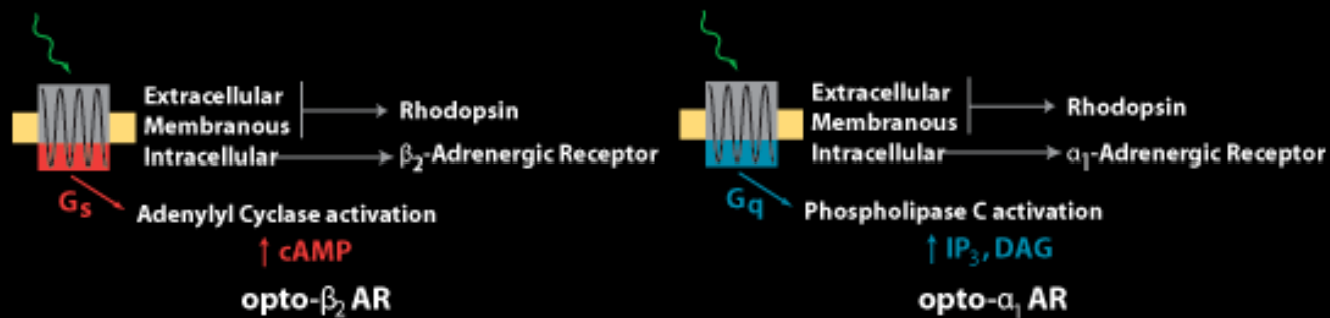
Neuron 71 July 14 2011



# Optogenetics

## Optical Control of Intracellular Signaling: Opto-XRs

Chimeric fusions of bovine Rhodopsin and adrenergic G-Protein Coupled Receptors allowing optical control of GPCR signaling cascades. Proteins are activated by 500nm light.



pcDNA3.1v5his-opto-a1AR-EYFP  
pcDNA3.1v5his-opto-b2AR-EYFP

[ [Vector Map](#) ]  
[ [Vector Map](#) ]

<http://www.stanford.edu/group/dlab/optogenetics/>





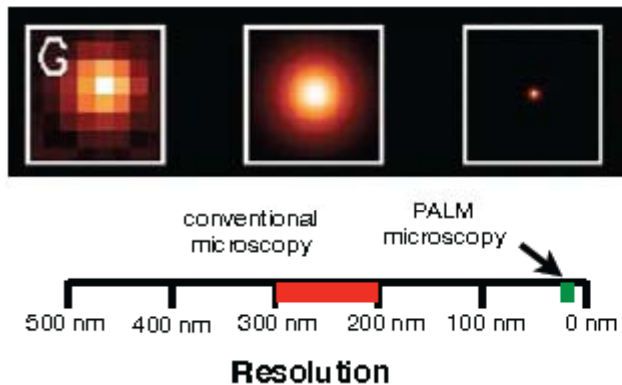
# Advance in Microscopy

## Photoactivated localization microscopy (PALM)

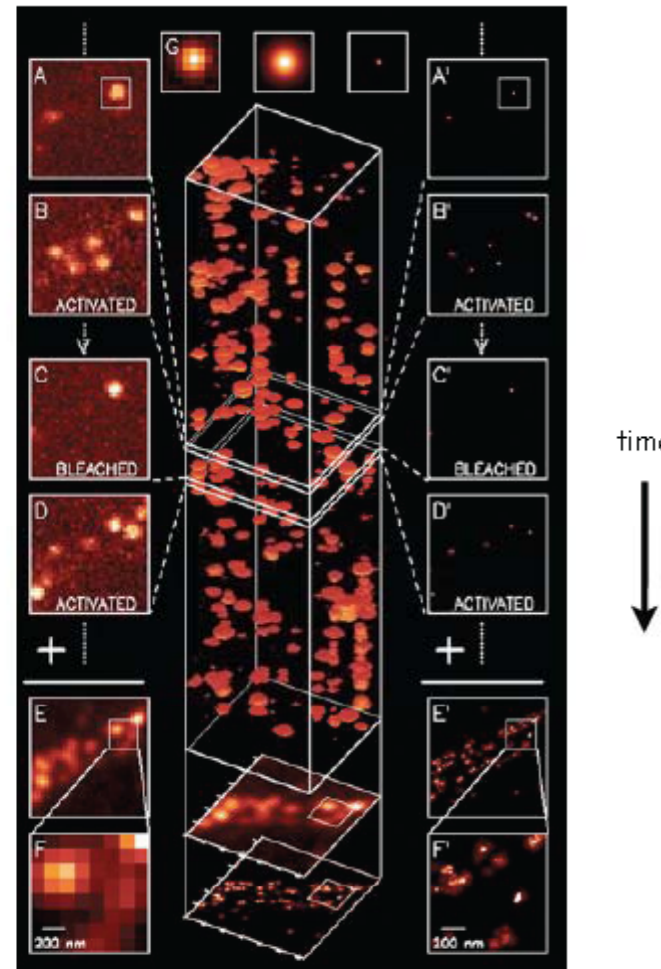


E. Betzig original PALM microscope

Centroids of isolated single fluorescent molecules can be determined to  $\pm 5\text{-}10\text{ nm}$

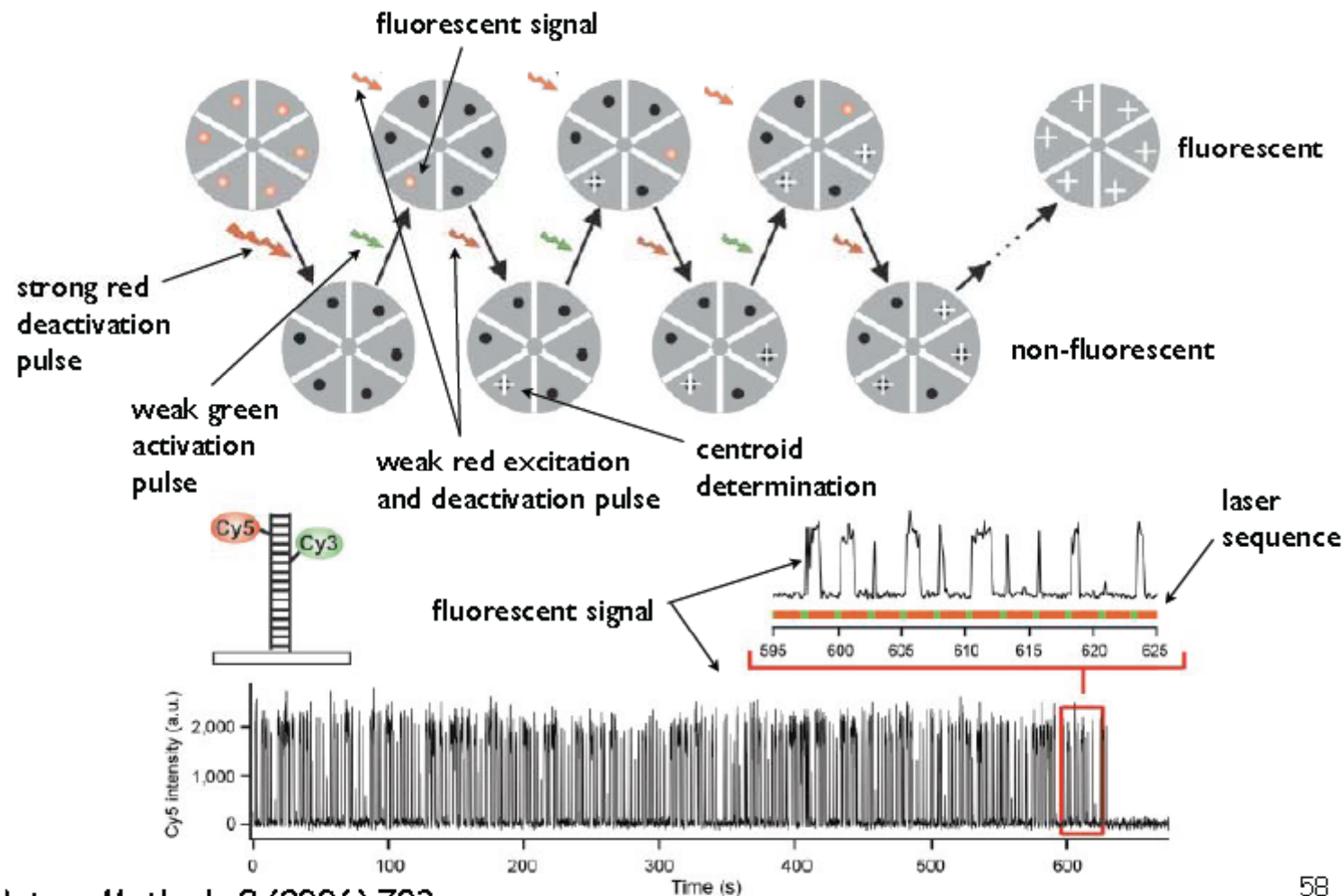


Betzig et al., Imaging Intracellular Fluorescent Proteins at Nanometer Resolution, Science 313 (2006) 1642



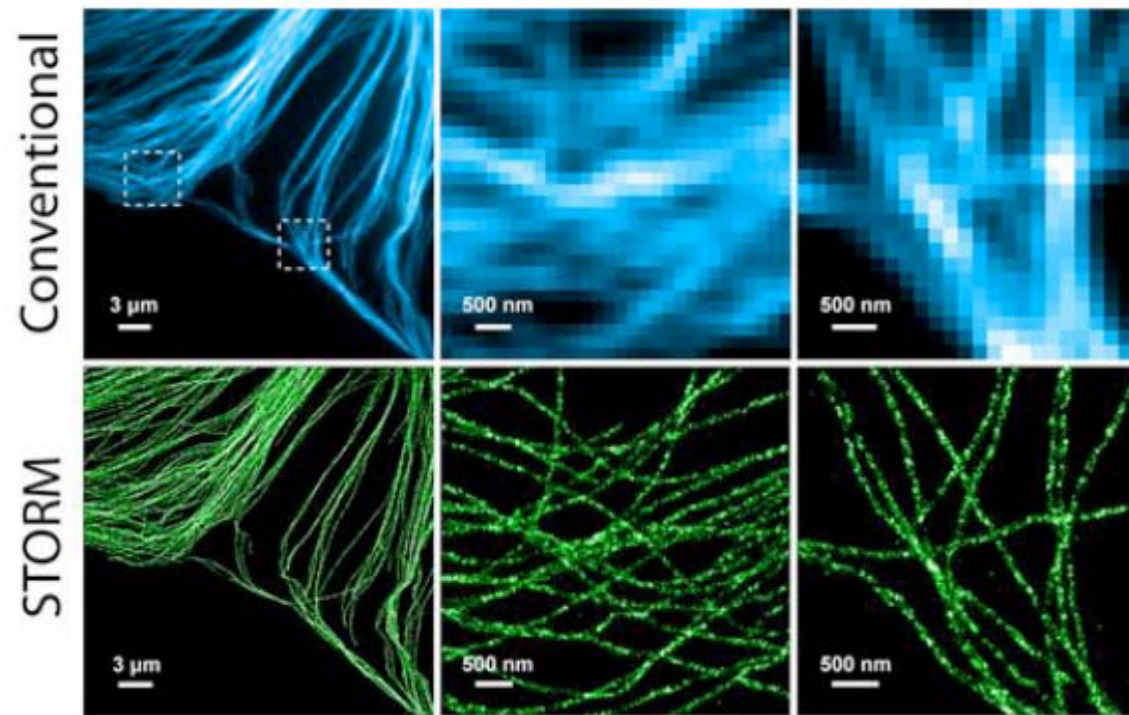
# Advance in Microscopy(2)

Schematic of a STORM imaging sequence showing the stochastic behavior



# Advance in Microscopy

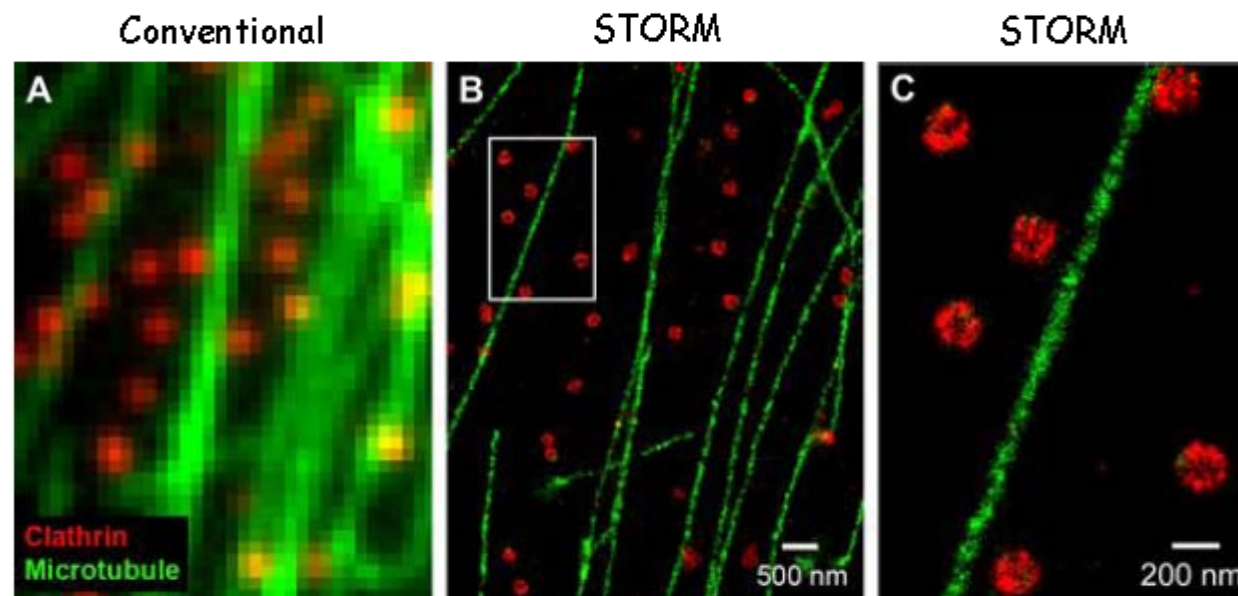
## STORM example



Comparison between conventional fluorescence and STORM images of microtubules in a mammalian cell. Microtubules were immunostained with antibodies that were labeled with photo-switchable Cy3-Alexa 647 pair. In the STORM image, each localization is plotted as a green spot, and the image is formed from thousands to millions of individual localizations.

# Advance in Microscopy

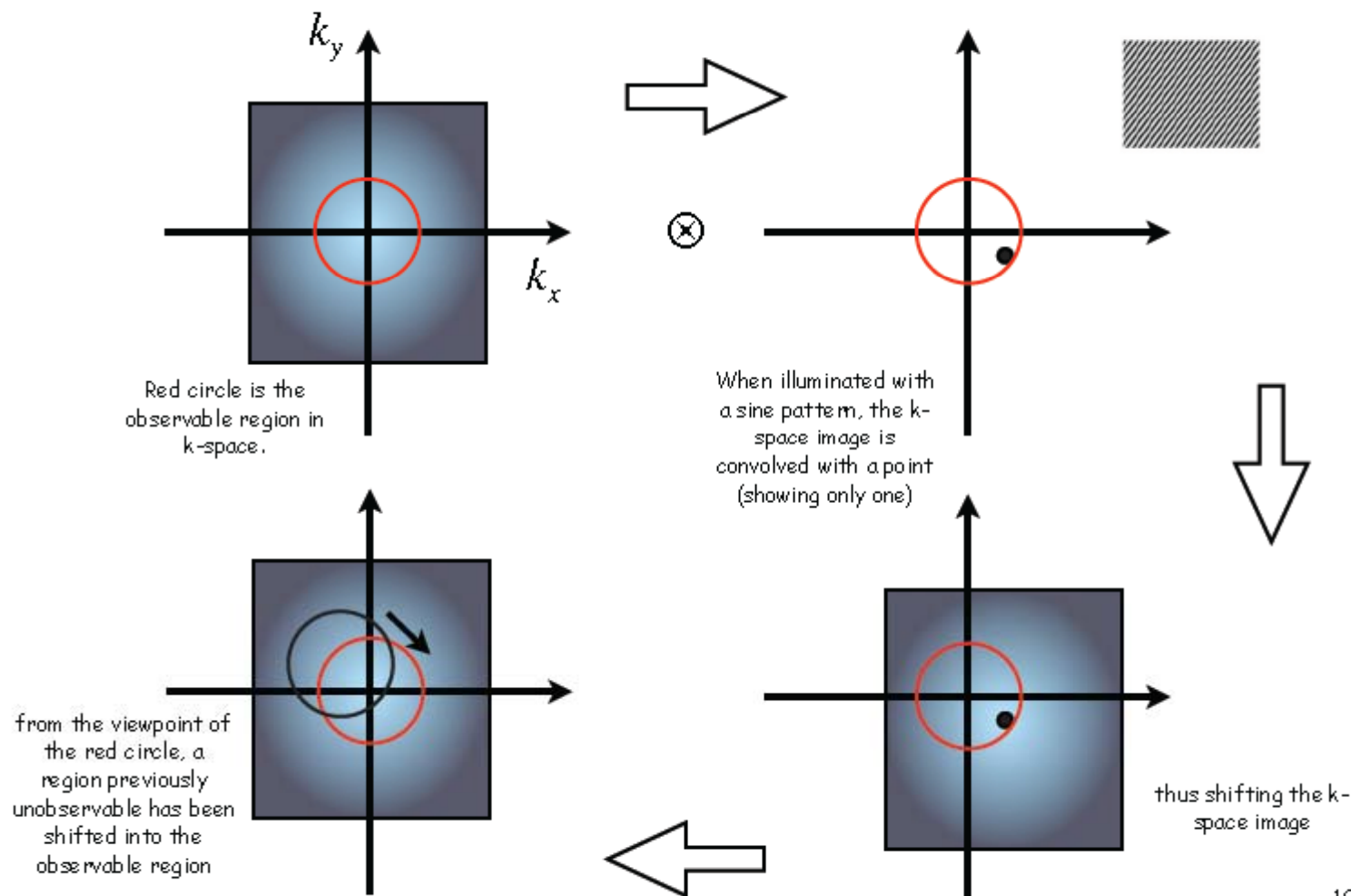
## Multicolor STORM



STORM images of microtubules and clathrin-coated pits (CCPs) in a BS-C-1 monkey kidney epithelial cell. Microtubules (green) and clathrin (red) were stained with antibodies labeled with Cy2-Alexa 647 pairs for microtubules and Cy3-Alexa 647 for CCPs.

# Advance in Microscopy

## The basic explanation of structured illumination microscopy

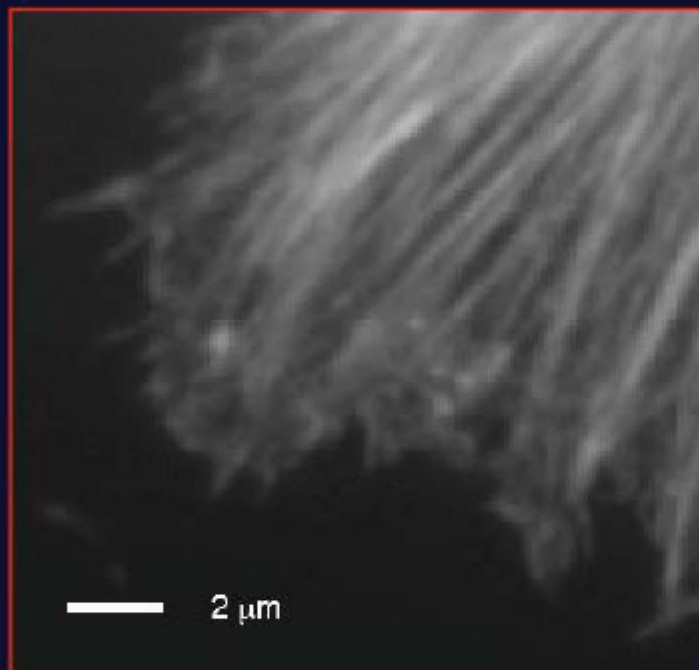




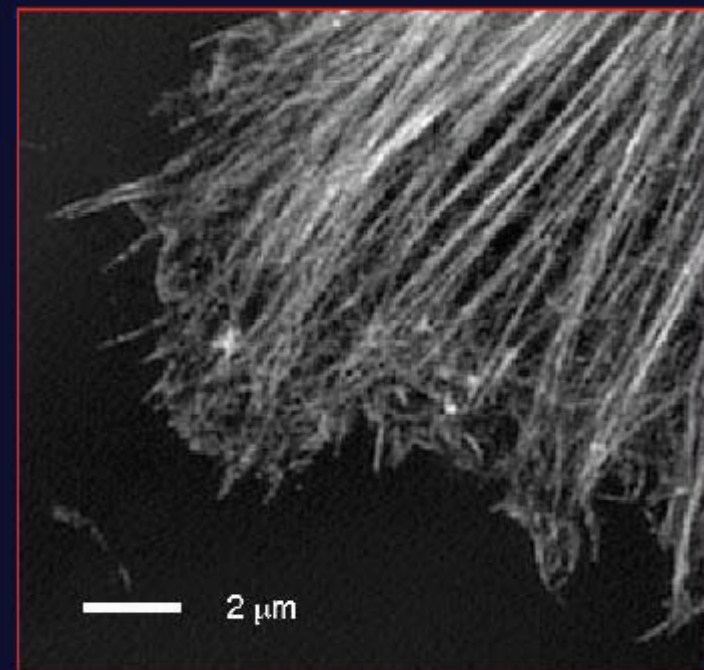
# Advance in Microscopy

## Resolution comparison Actin in a HeLa cell

Conventional microscopy



Structured illumination  
final reconstruction



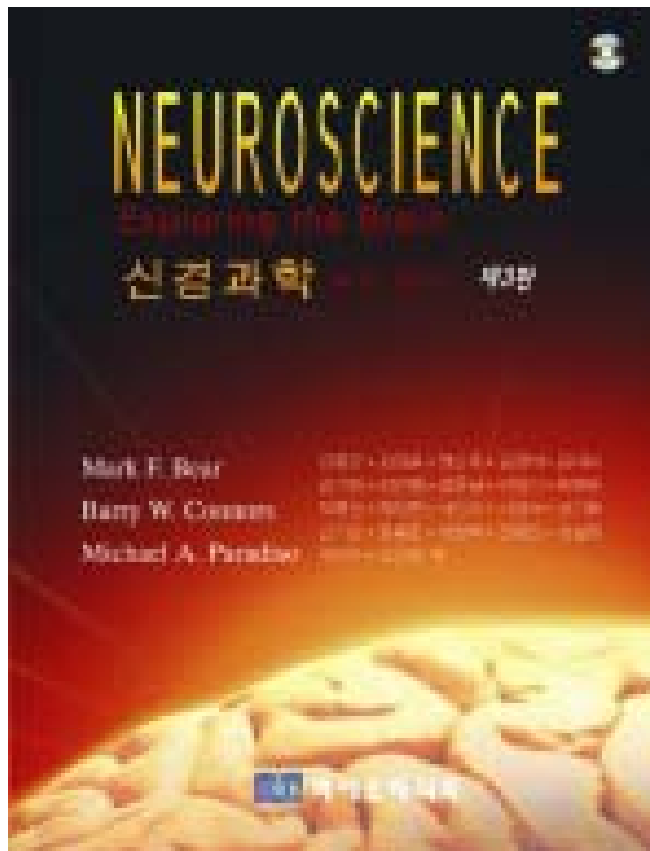
# 계획

## ■ 학습 주제: 의식은 생물학적으로 어떻게 설명될 수 있을까-수준에 따른 탐구

	주제	교과서/참고서 해당 장*
첫 번째 달	신경생물학의 최신지견, 입문 & OT	ch 1
두 번째 달	특별한 신경세포	ch 2 3 4
세 번째 달	시냅스에 대한 거의 모든 것! Part 1	ch 5 6
네 번째 달	시냅스에 대한 거의 모든 것! Part 2	ch 23 24 25
다섯 번째 달	신경네트워크와 지도(맵핑)	
여섯 번째 달	신경생물학과 행동	ch 13 14 15 16
일곱 번째 달	신경생물학과 인지 Part 1	ch 8 9 10 11 12
여덟 번째 달	신경생물학과 인지 Part 2	ch 17 18 19 21
아홉 번째 달	신경생물학과 언어	ch 20
마지막 달	신경질환	ch 22

# 계획

## ■ 교과서



[신경과학:뇌의 탐구(3판) Bear (강  
봉균 외 역)/ 바이오메디북/2009]



# 참고사이트



<http://thebrain.mcgill.ca/>