

讨论课

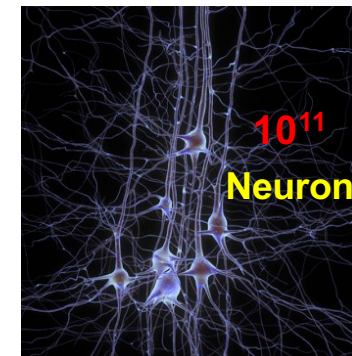
1. 能在极端环境下生活的生物（如深海鱼、水熊虫）的特性，对材料科学有什么启发？
2. 转基因猪用于人类器官移植，有哪些进展和挑战？
3. 有的动物毒素非常危险甚至致命，但它们也可以为我们所用。试举例说明。
4. 抑郁症的症状有哪些？请简要概括目前的诊断和治疗方法，并讨论其局限性。
5. 阿尔茨海默症的症状有哪些？请简要概括目前的诊断和治疗方法，并讨论其局限性。
6. 精神分裂症的症状有哪些？请简要概括目前的诊断和治疗方法，并讨论其局限性。

Nervous Systems

Yang Yang, PhD

Outline

- Brain 大脑
 - Anatomy and function
- Neuron 神经元
 - Structure: dendrite and axon
 - Function: resting and action potential
- Synapse 突触
 - Signal transduction
 - Synaptic plasticity



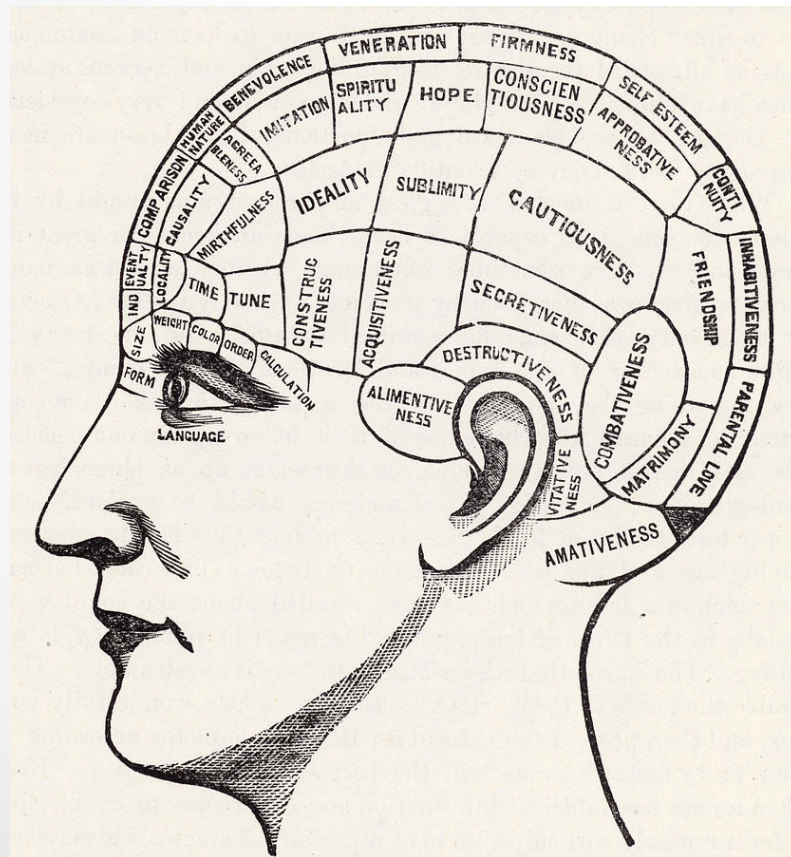
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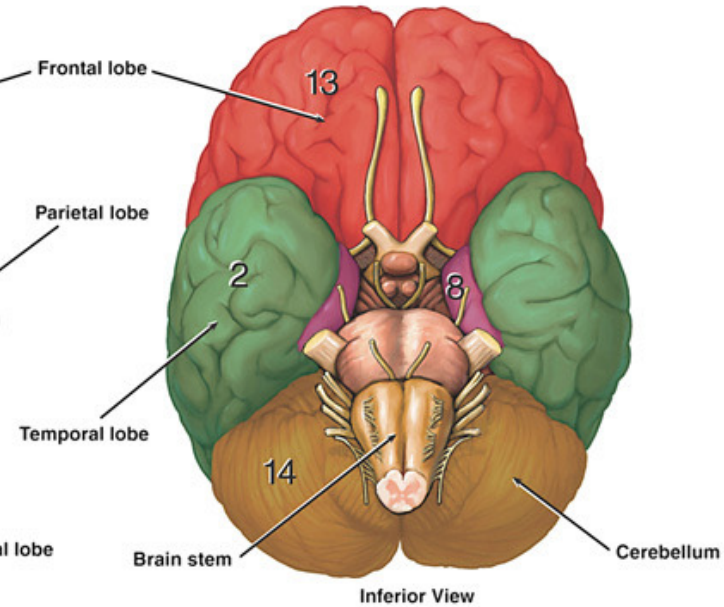
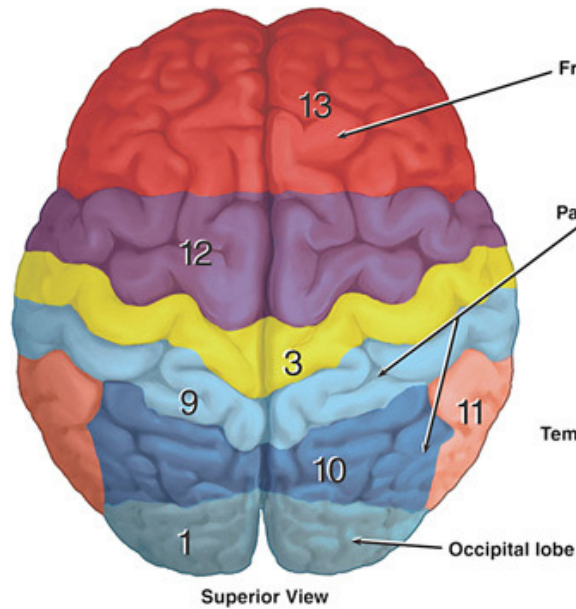
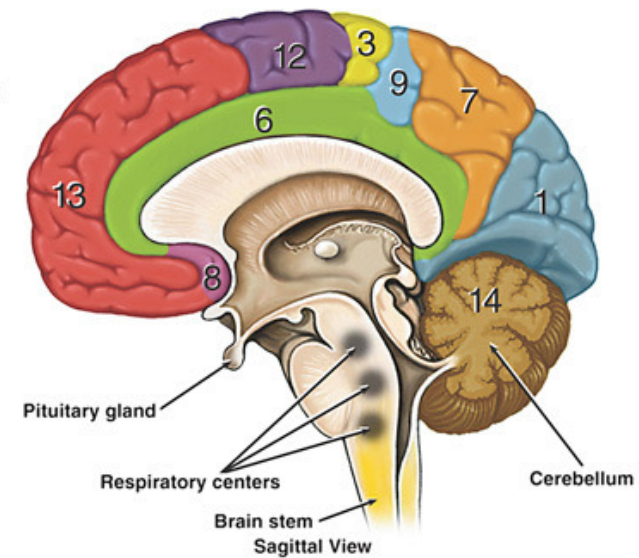
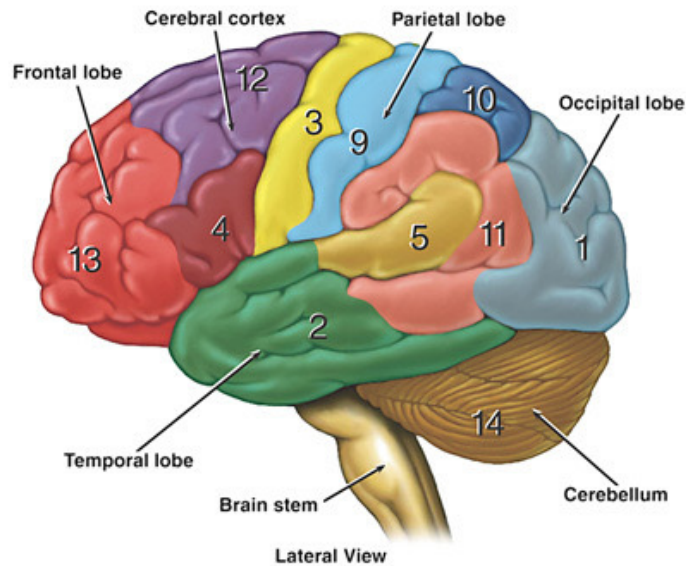
Brain: anatomy and function

Phrenology 颅相学

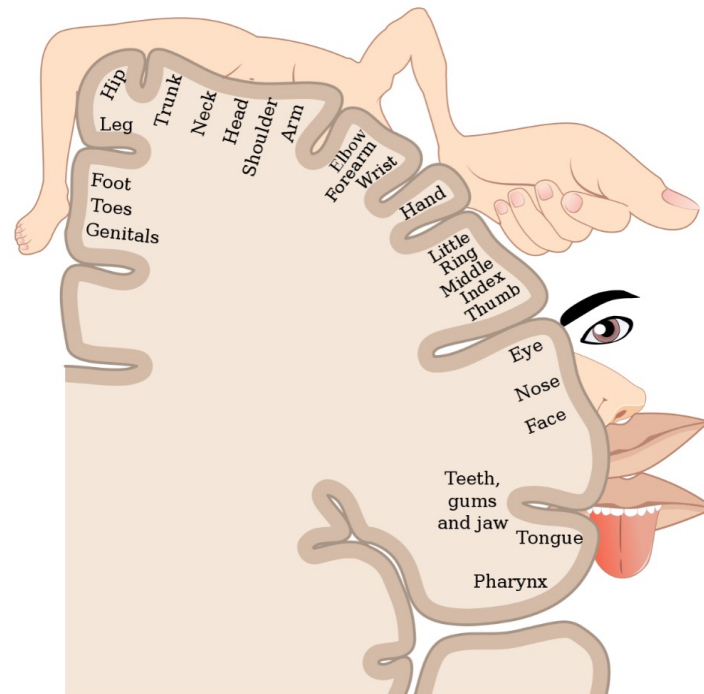
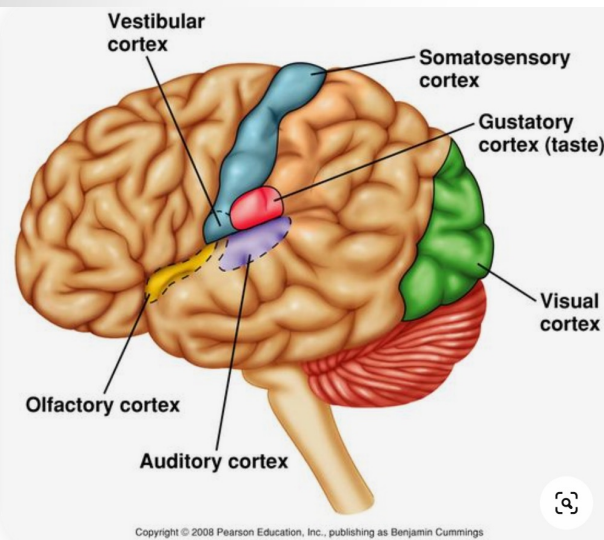


Functional Areas of the Cerebral Cortex

- 1 **Visual Area:**
Sight
Image recognition
Image perception
 - 2 **Association Area**
Short-term memory
Equilibrium
Emotion
 - 3 **Motor Function Area**
Initiation of voluntary muscles
 - 4 **Broca's Area**
Muscles of speech
 - 5 **Auditory Area**
Hearing
 - 6 **Emotional Area**
Pain
Hunger
"Fight or flight" response
 - 7 **Sensory Association Area**
 - 8 **Olfactory Area**
Smelling
 - 9 **Sensory Area**
Sensation from muscles and skin
 - 10 **Somatosensory Association Area**
Evaluation of weight, texture, temperature, etc. for object recognition
 - 11 **Wernicke's Area**
Written and spoken language comprehension
 - 12 **Motor Function Area**
Eye movement and orientation
 - 13 **Higher Mental Functions**
Concentration
Planning
Judgment
Emotional expression
Creativity
Inhibition
- ## Functional Areas of the Cerebellum
- 14 **Motor Functions**
Coordination of movement
Balance and equilibrium
Posture



Somatosensory 躯体感觉



wikipedia.com



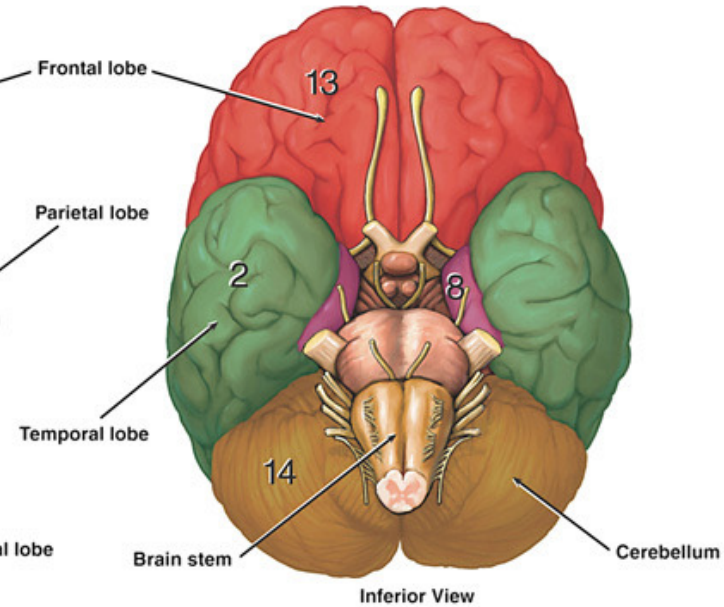
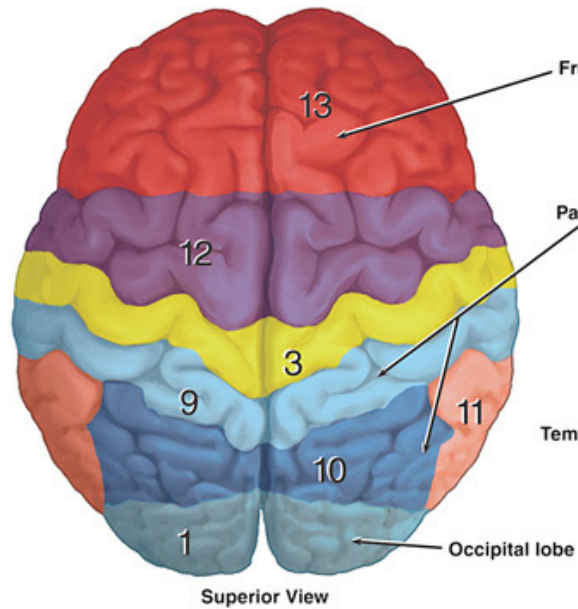
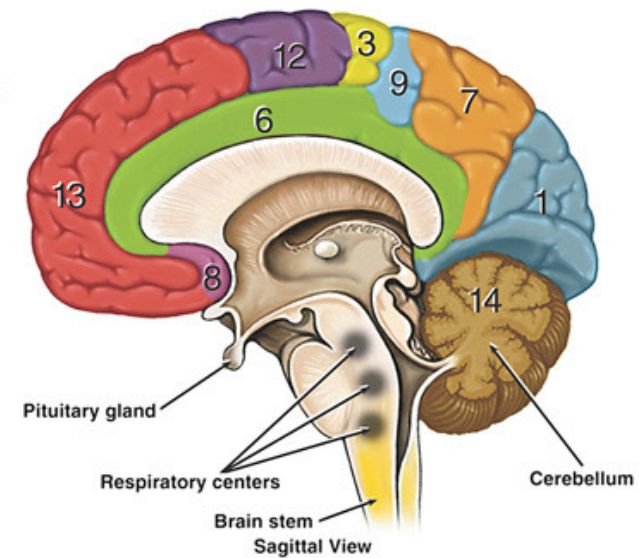
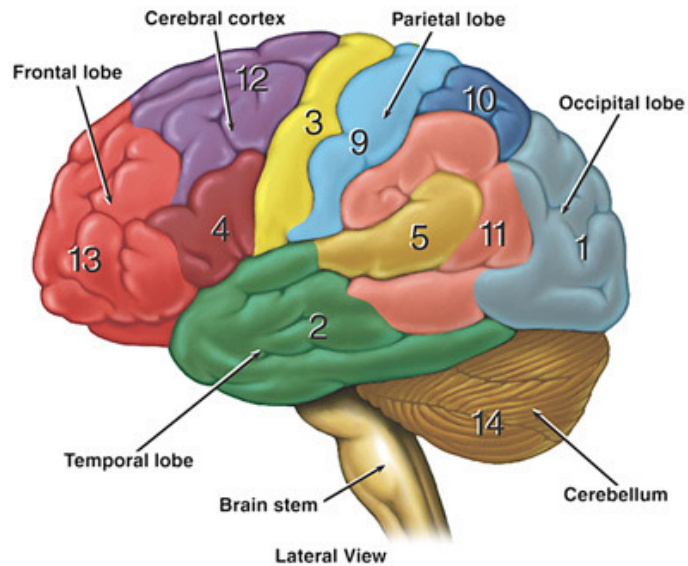
amazon.com

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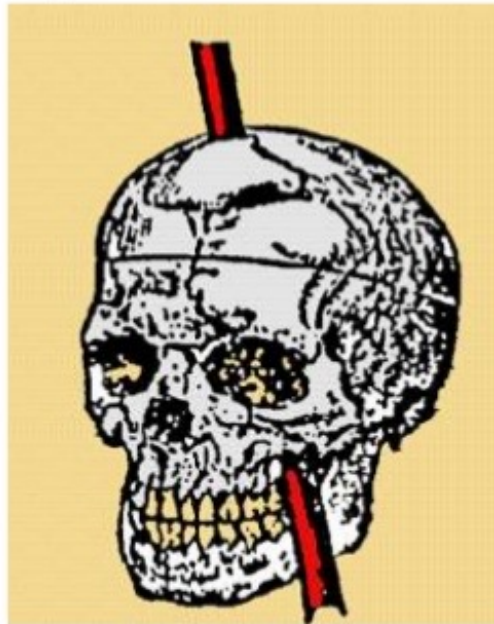


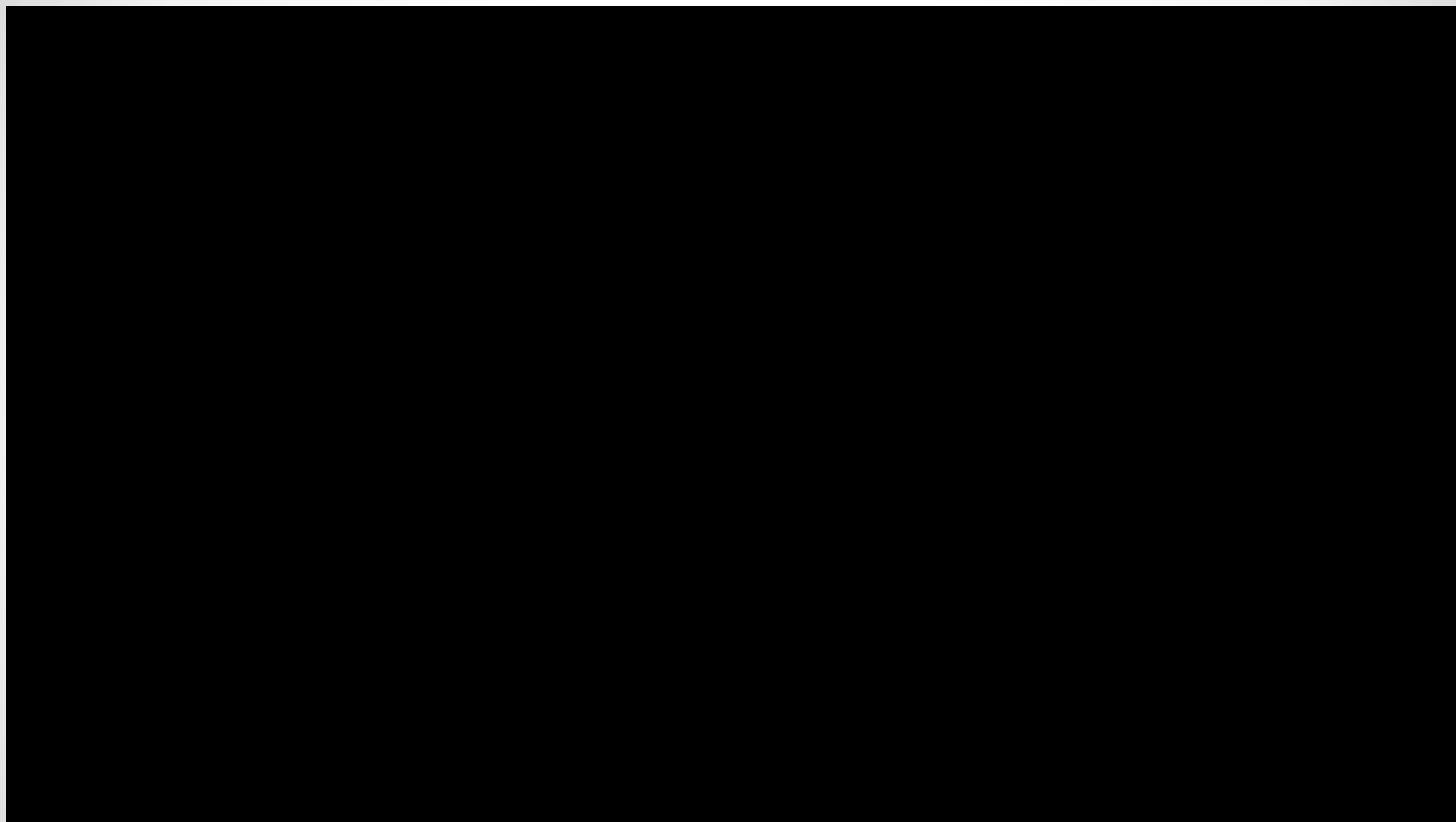
Prefrontal cortex 前额叶皮层

Higher cognitive functions

The Case of Phineas Gage (Harlow 1868)

- Tamping iron blown through skull: L frontal brain injury
- Excellent physical recovery
- Dramatic personality change
'no longer Gage': stubborn, lacked in consideration for others, had profane speech, failed to execute his plans





Grunge@YouTube •



(Official Selection - Toronto Film Festival) (Official Selection - Venice Film Festival) (Official Selection - Sundance Film Festival)

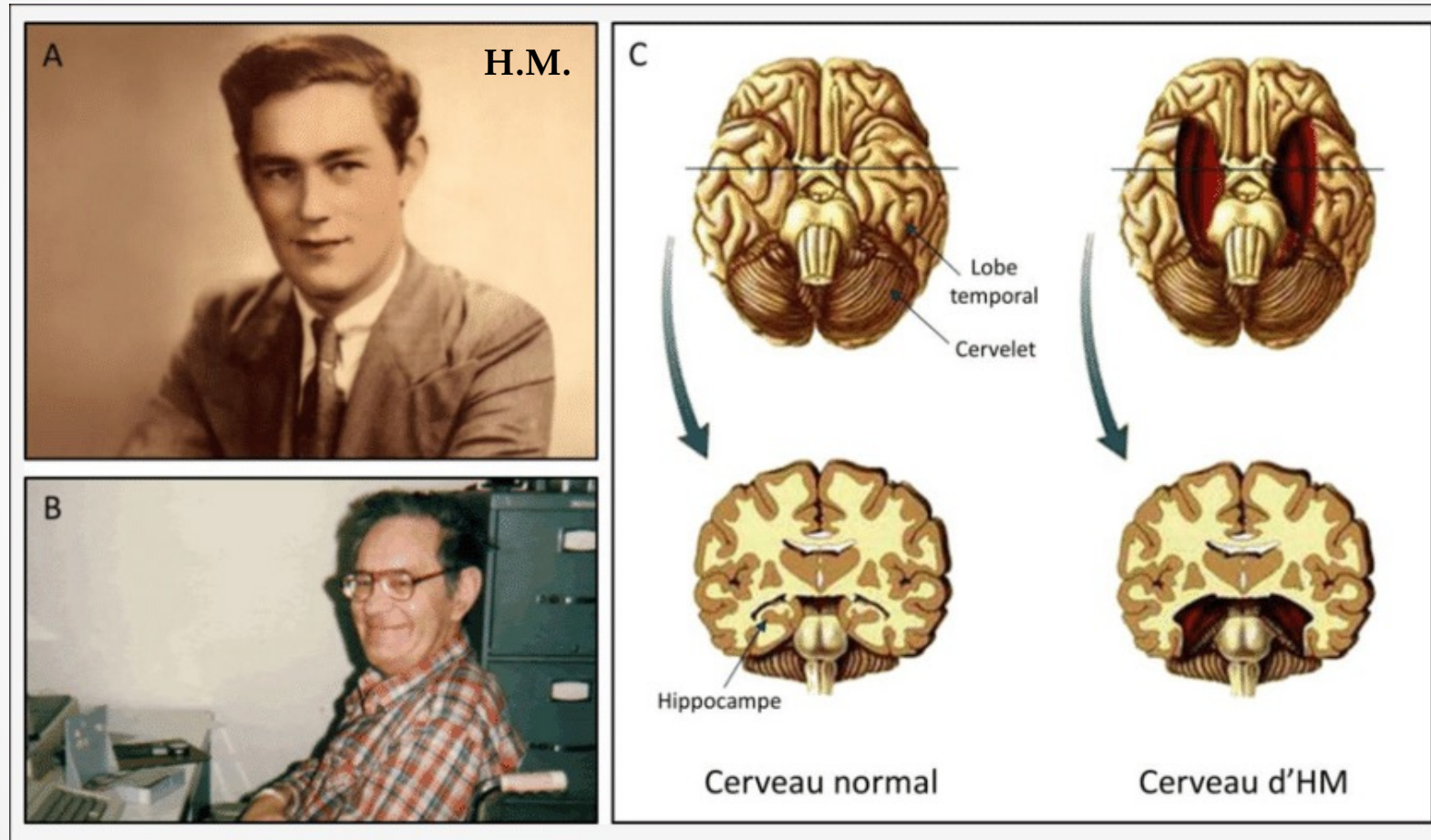
GUY PEARCE CARRIE-ANNE MOSS JOE PANTOLIANO

MEMENTO

NEWMARKET PRESENTS AN ASSOCIATION WITH SUMMIT ENTERTAINMENT A TEAM TODD PRODUCTION A FILM BY CHRISTOPHER NOLAN GUY PEARCE CARRIE-ANNE MOSS JOE PANTOLIANO "MEMENTO"
PRODUCED BY JOHN PAPSODRA, C.S.A. AND ARON HYDER WRITTEN BY PATRICK DOBSON AND PATRICK DOBSON DIRECTED BY CHRISTOPHER NOLAN
CASTING BY SUZANNE TODD AND JENNIFER TODD COSTUME DESIGNER WILLIAM PIERRE MUSIC BY JONATHAN NOLAN EDITOR CHRISTOPHER NOLAN EXECUTIVE PRODUCERS WILLIAM PIERRE AND CHRIS J. BALL PRODUCED BY CHRISTOPHER NOLAN
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Hippocampus 海马体



Brenda Milner

Patient H. M. (Henry Molaison)

PACKARD
Two Great New Lines of Cars for '53!

*The Luxurious PACKARD—
America's New Choice In The Fine-Car Field!*

HERE—for '53—a great new car in the quality field—the brilliant new PACKARD. With the world's highest-compression eight, Packard provides power to spare, the finest of all no-shift drives, power steering and power brakes.

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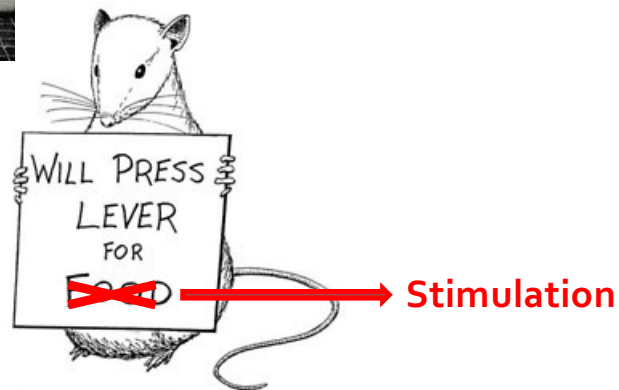
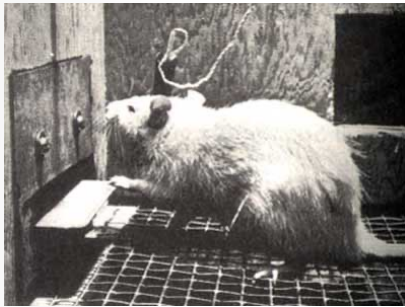
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Big-Car Value At Medium-Car Cost!*

NOW PACKARD offers an entirely new line—Packard CLIPPERS—for big-car value at medium-car cost. These true products of Packard experience, engineering and skill give you Packard quality at a price within the average family's income.

POWERED BY PACKARD's mighty Thunderbolt Eight Engines, they are the roomiest cars in their price class. So no matter what you plan to spend for a car, PACKARD—with two great new lines—offers you your *best motorcar investment.*

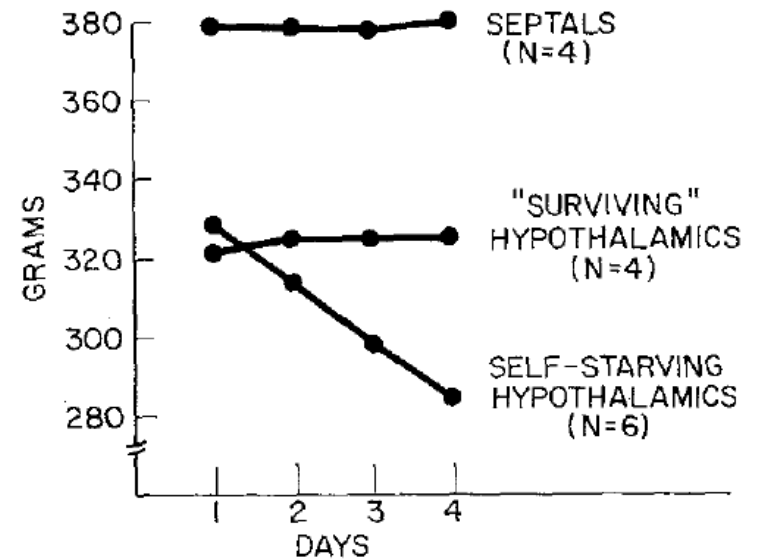
Reward system

- Apparatus: Skinner box



"Positive reinforcement produced by electrical stimulation of septal area and other regions of rat brain."

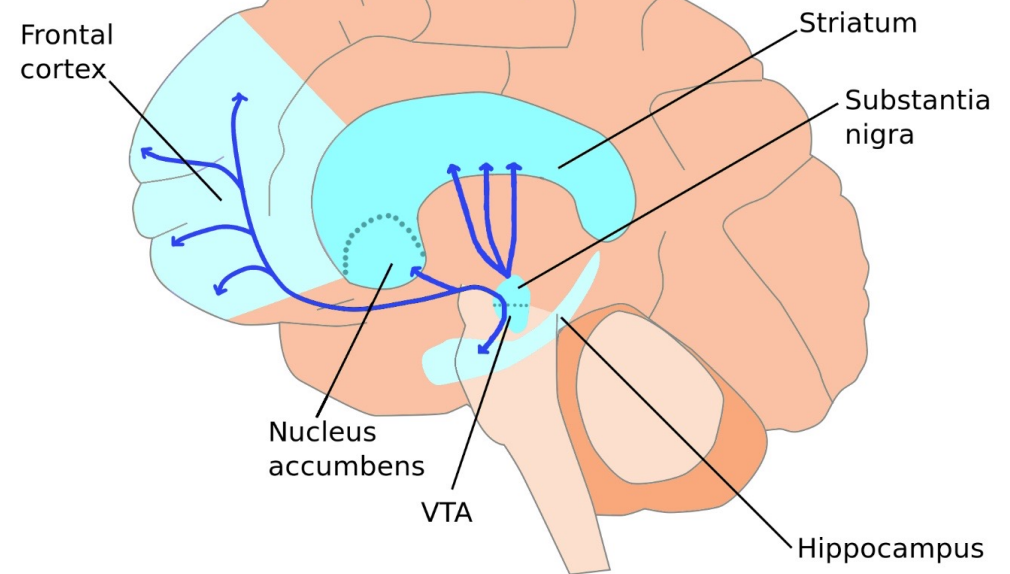
Olds and Milner, 1954



Routtenberg and Lindy 1965

Reward system: dopamine

- Ventral tegmental area (**VTA**) projects to Nucleus Accumbens (**NAc**)
- VTA projects to frontal cortex
- VTA releases **dopamine** 多巴胺
- Dopamine is also involved in motor control



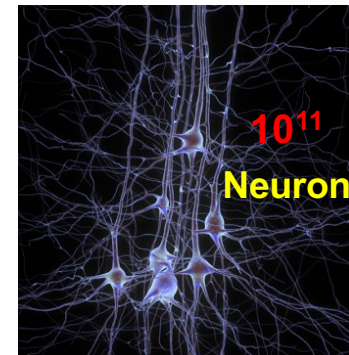
Wikipedia.com

Addiction



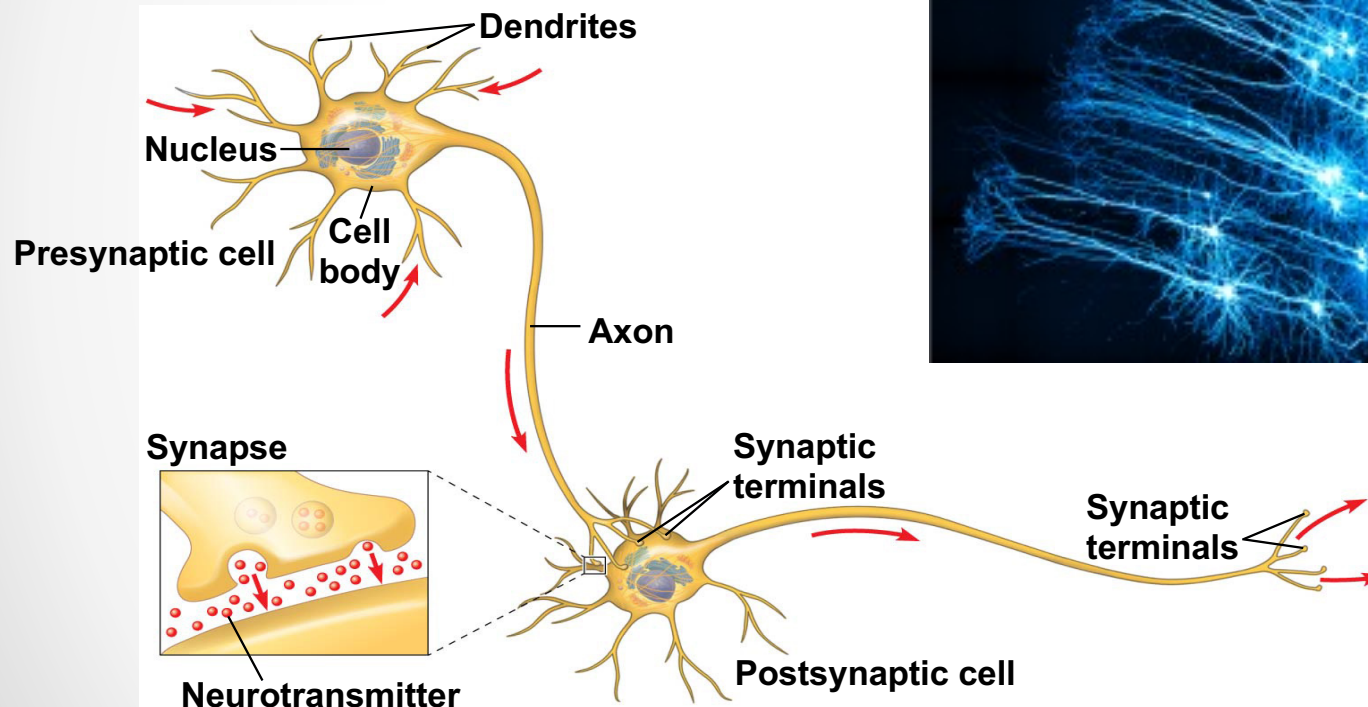
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Neuron: Structure

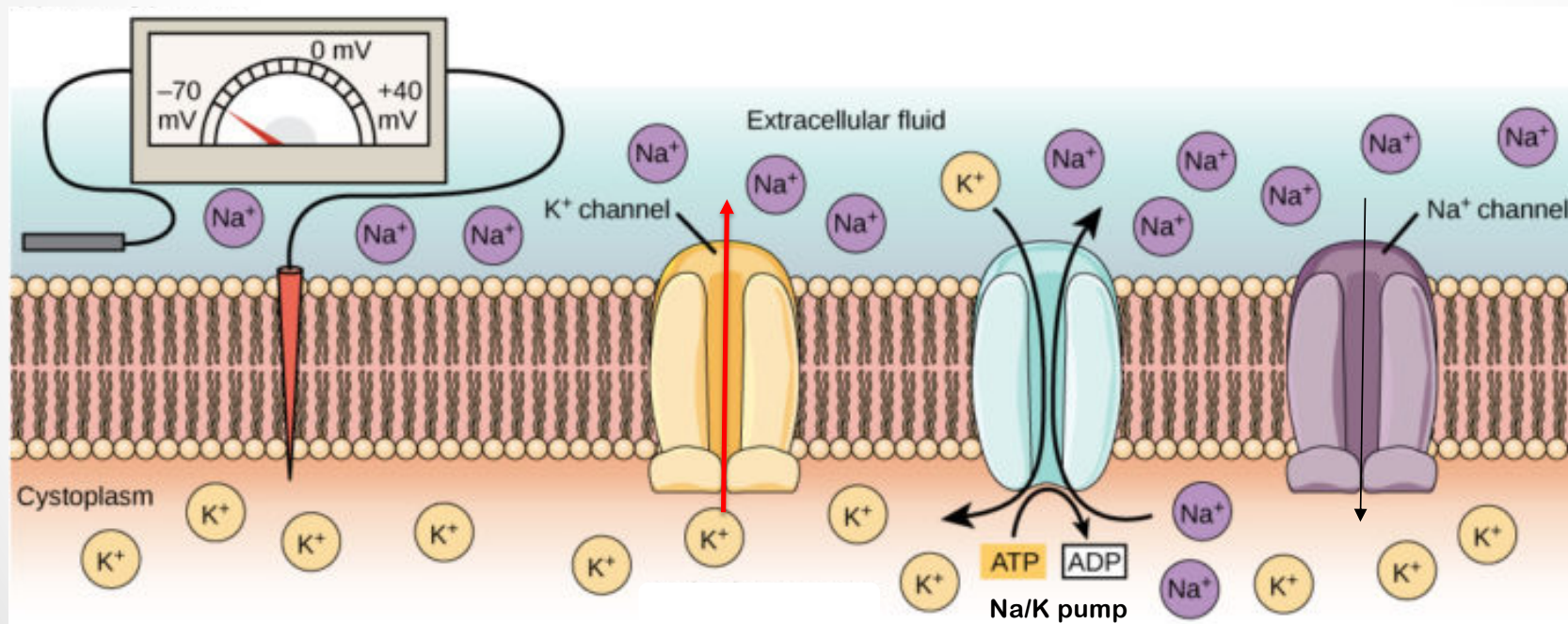
- **Dendrite** 树突: branched extensions that *receive* signals from other neurons
- **Axon** 轴突: a much longer extension that *transmits* signals to other neurons



The Scientist

Resting potential 静息电位

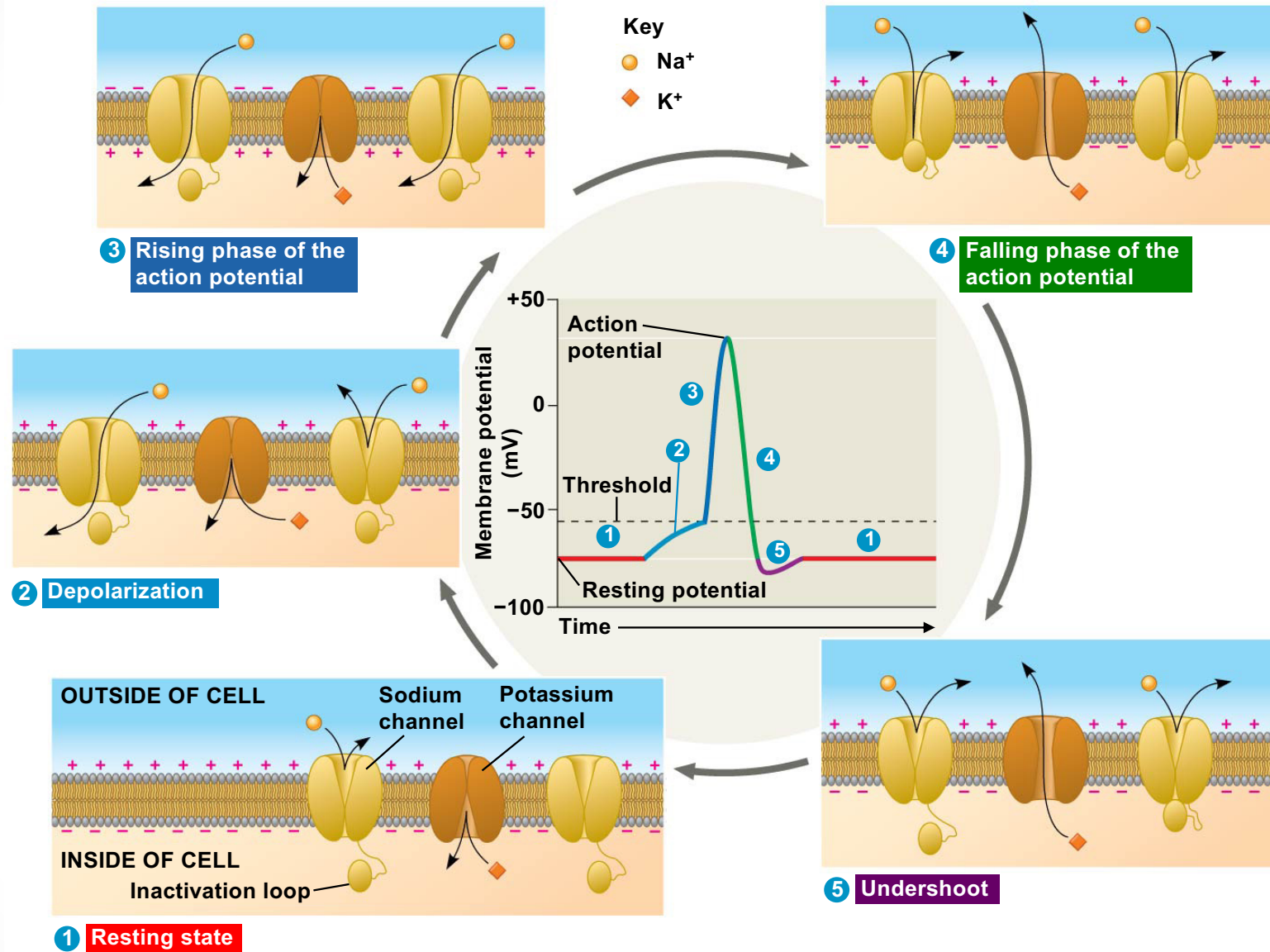
- Inside cell: High K^+ , Low Na^+ .
- Neuron at rest: **K^+ leak channels** open.
- Resting potential: around -70mV.



Action potential

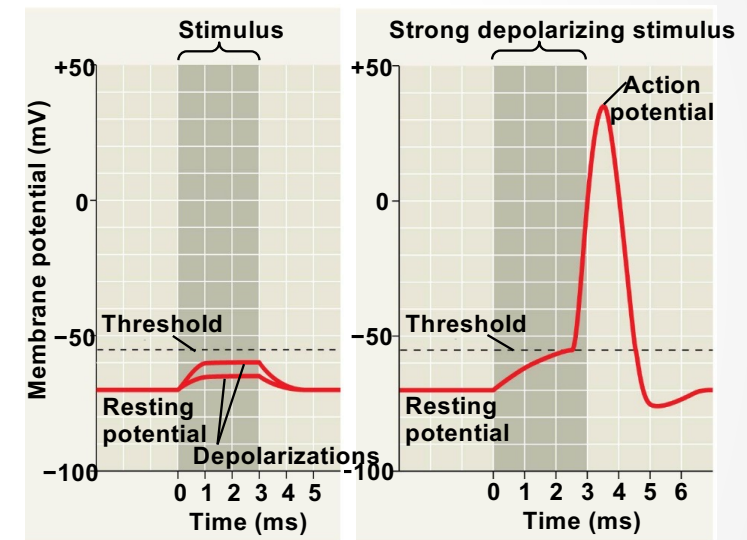
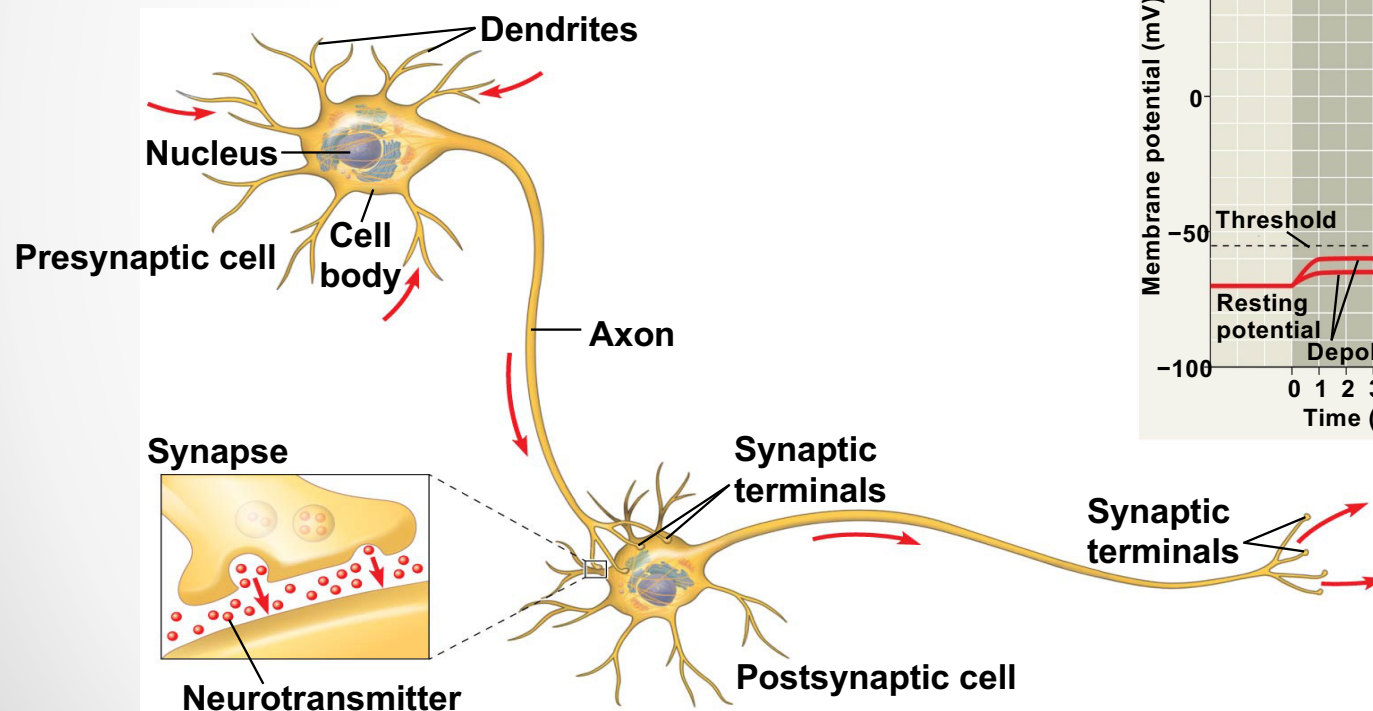
动作电位

1. Most channels closed
2. Ligand-gated channels open
配体门控通道打开
3. Voltage-gated Na^+ channels open
电压门控钠通道打开
4. Voltage-gated Na^+ channels inactivated; voltage-gated K^+ channels open
电压门控钠通道失活，电压门控钾通道打开
5. Voltage-gated K^+ channels close and resting potential restored
电压门控钾通道关闭，电压门控钠通道关闭

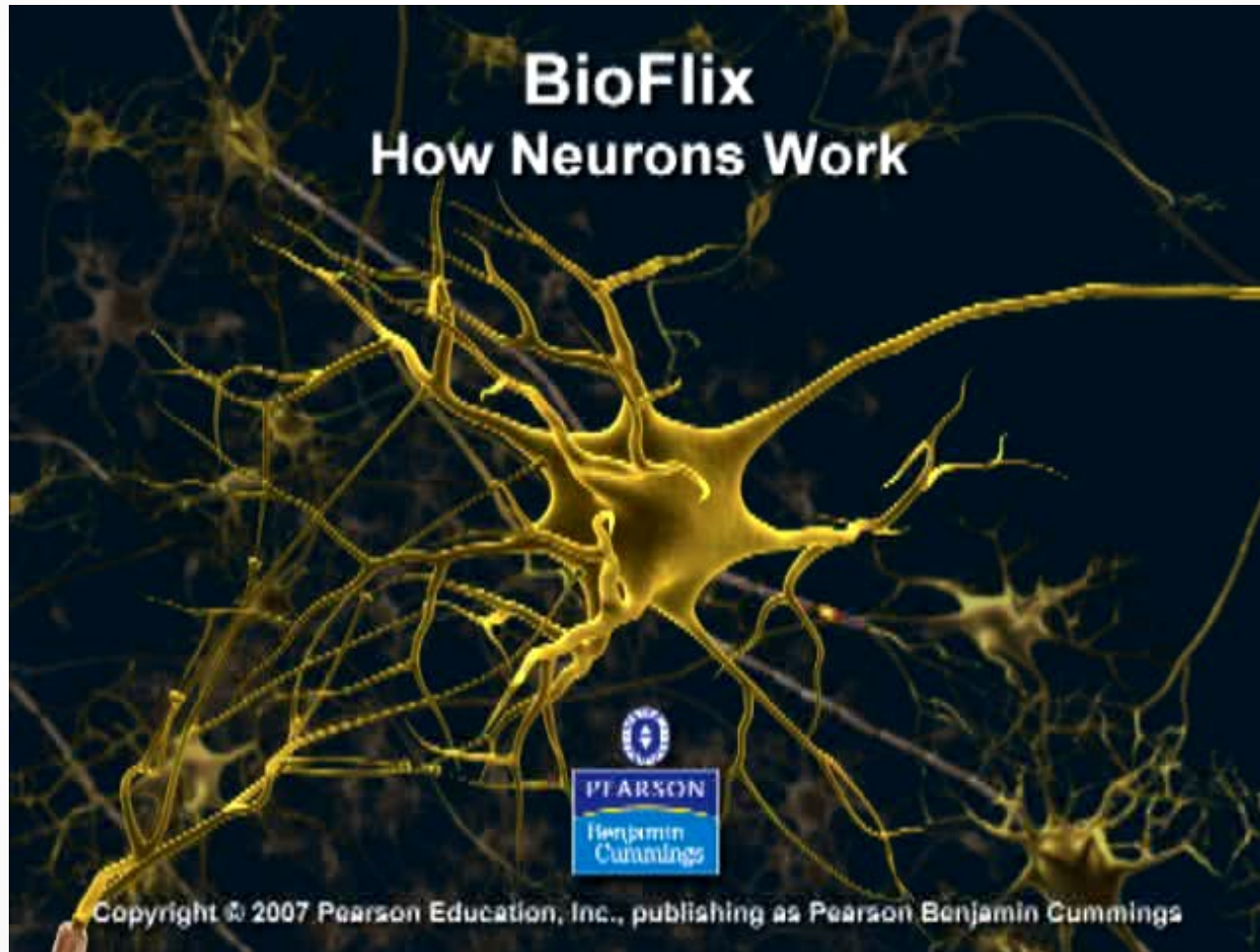


Signal transduction: Action Potentials

- **One direction:** presynaptic cell → postsynaptic cell
- **All-or-none** 全或无

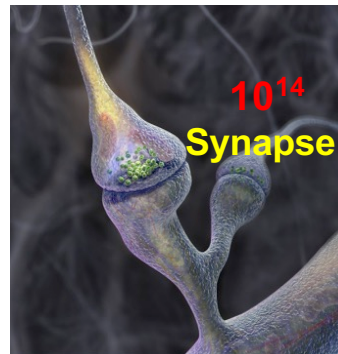


How Neurons Work



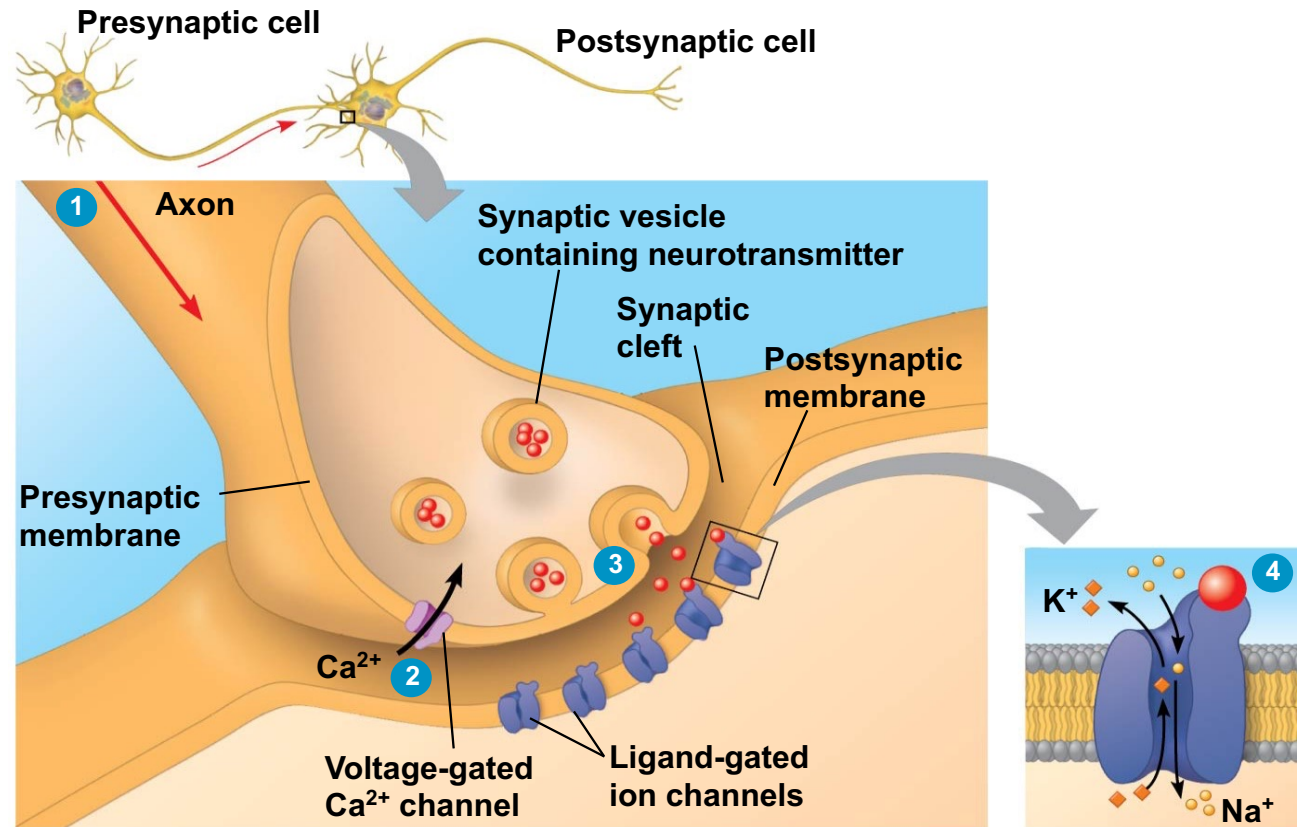
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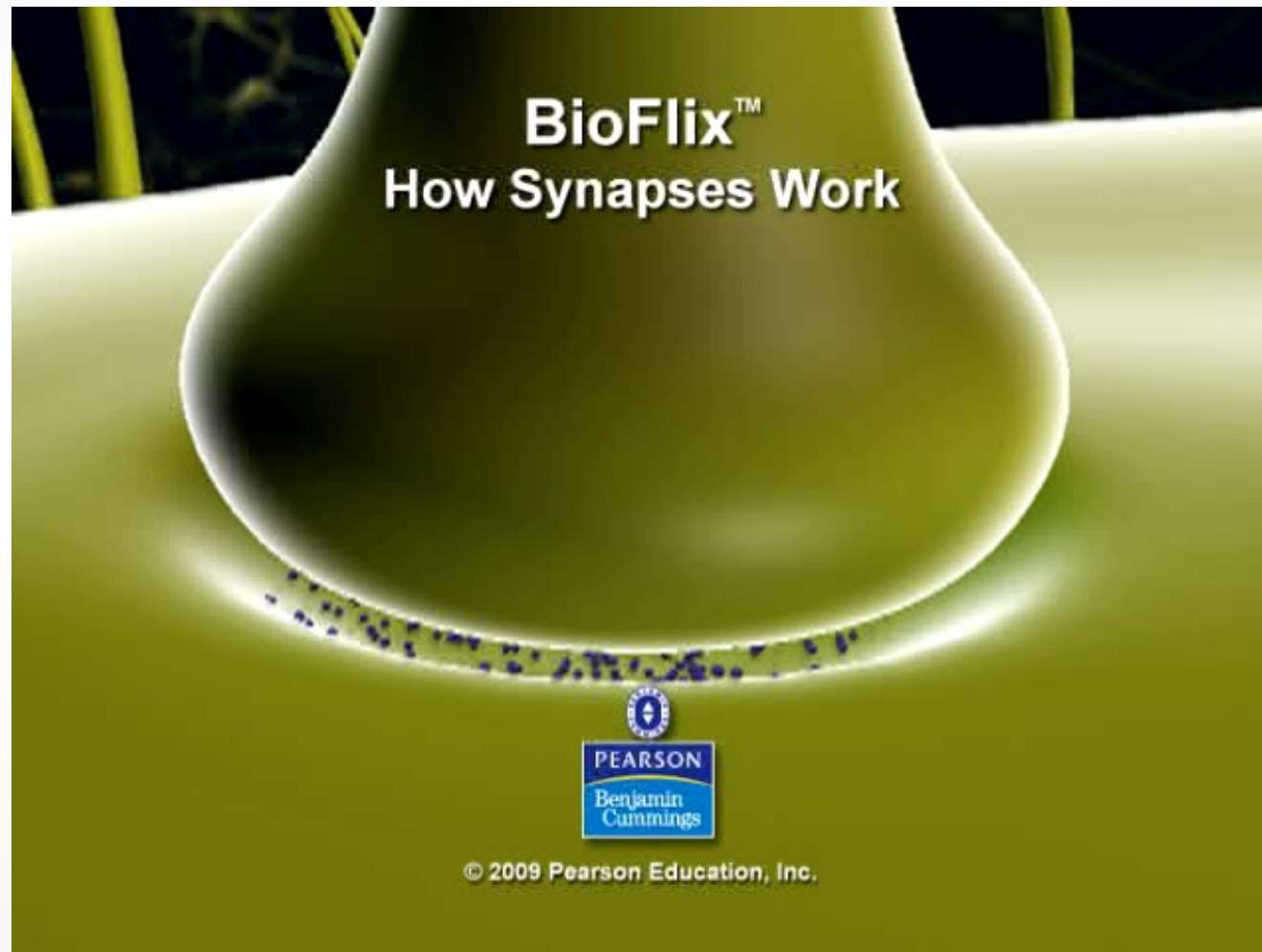


Synaptic transmission

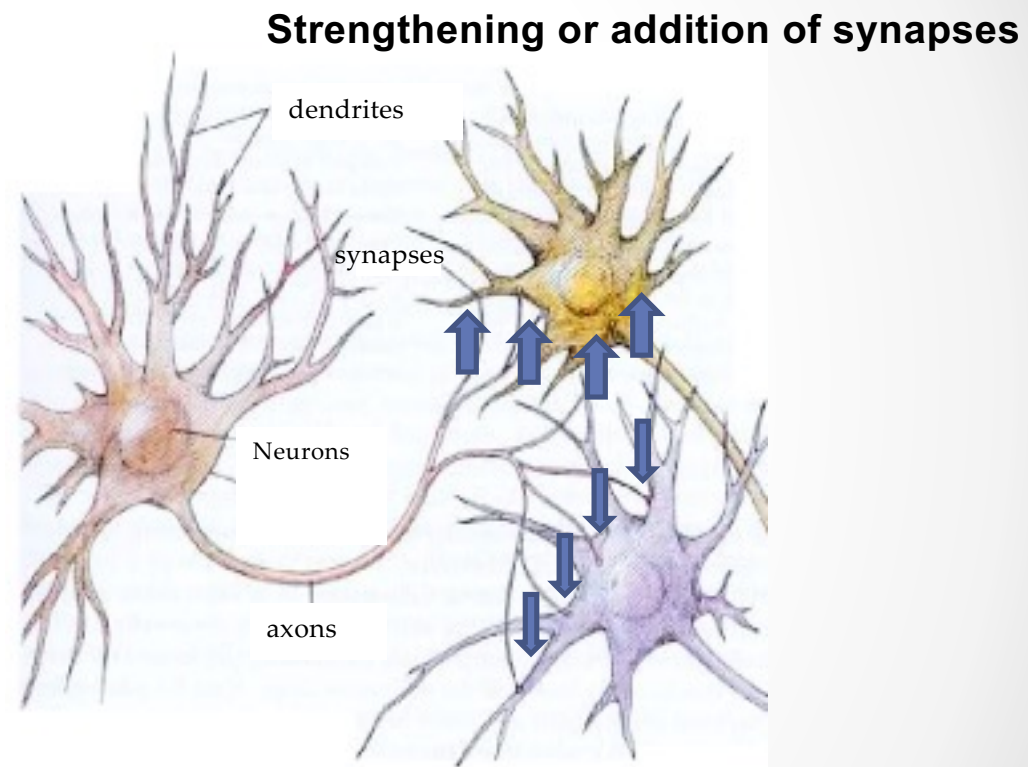
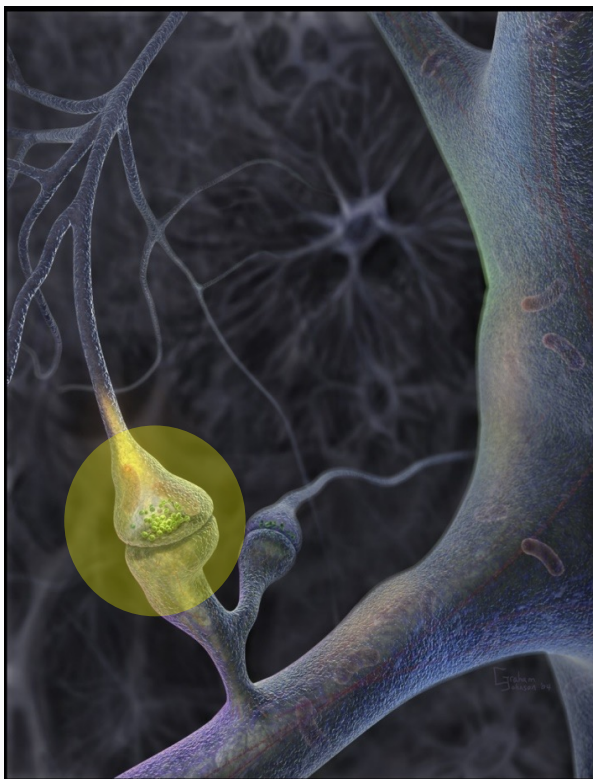
- Presynaptic action potential opens **voltage-gated calcium channels**, leading to **neurotransmitter release**
神经递质释放
- Binding of neurotransmitters causes **ligand-gated ion channels** 配体门控离子通道 in the postsynaptic cell to open, generating a postsynaptic potential (excitatory or inhibitory)



How Synapses Work



Synaptic plasticity: neural basis of learning



weakening or elimination of synapses

Synaptic plasticity: Hebbian theory

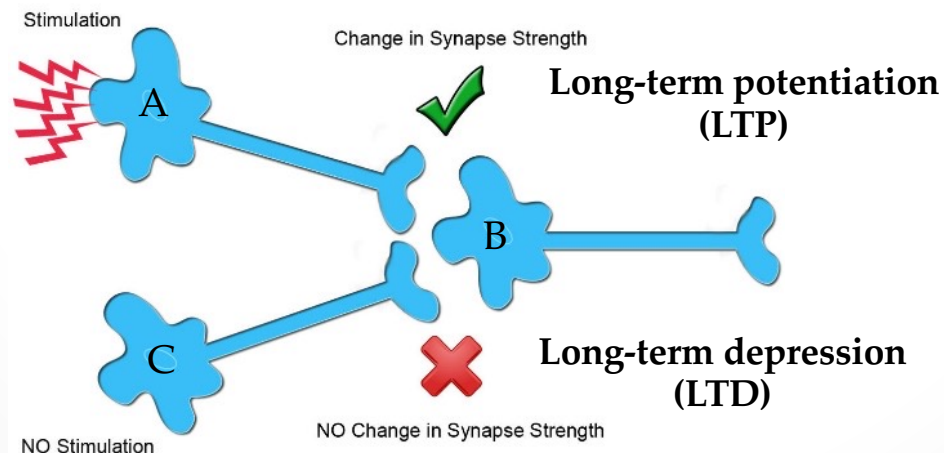
- Hebb's postulate

- **Donald Hebb**, 1949: "When an axon of cell A ... excite(s) cell B and repeatedly or persistently takes part in firing it, **some growth process or metabolic change takes place** such that A's efficiency, as one of the cells firing B, is increased."

(Fire together, wire together)



Donald O. Hebb
1904-1985



Synaptic plasticity and learning



www.AlilaMedicalMedia.com