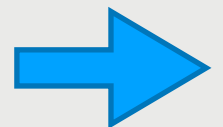


NEUROPLASTICITY



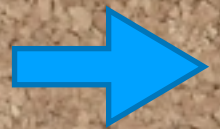
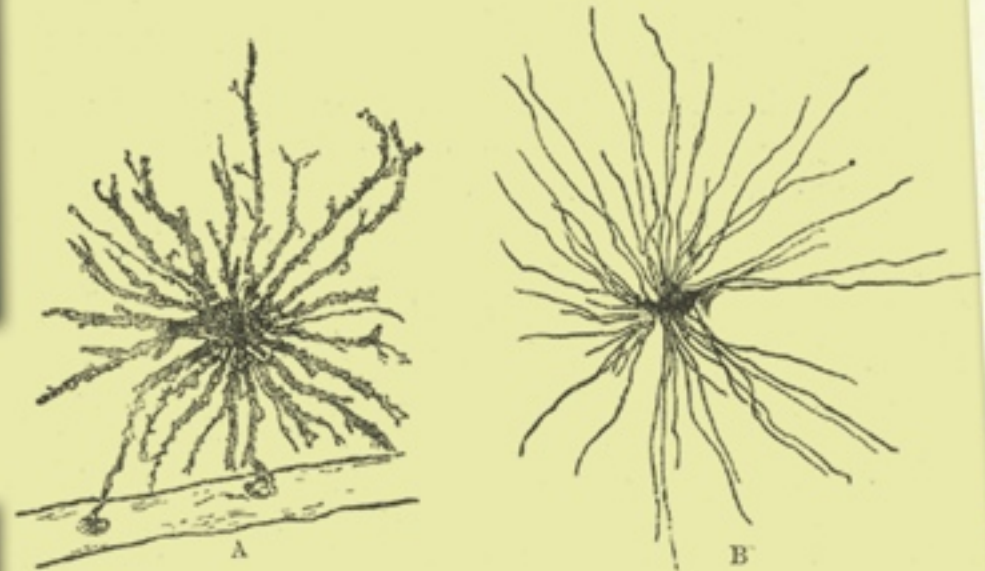
Neuro - plastic - ity

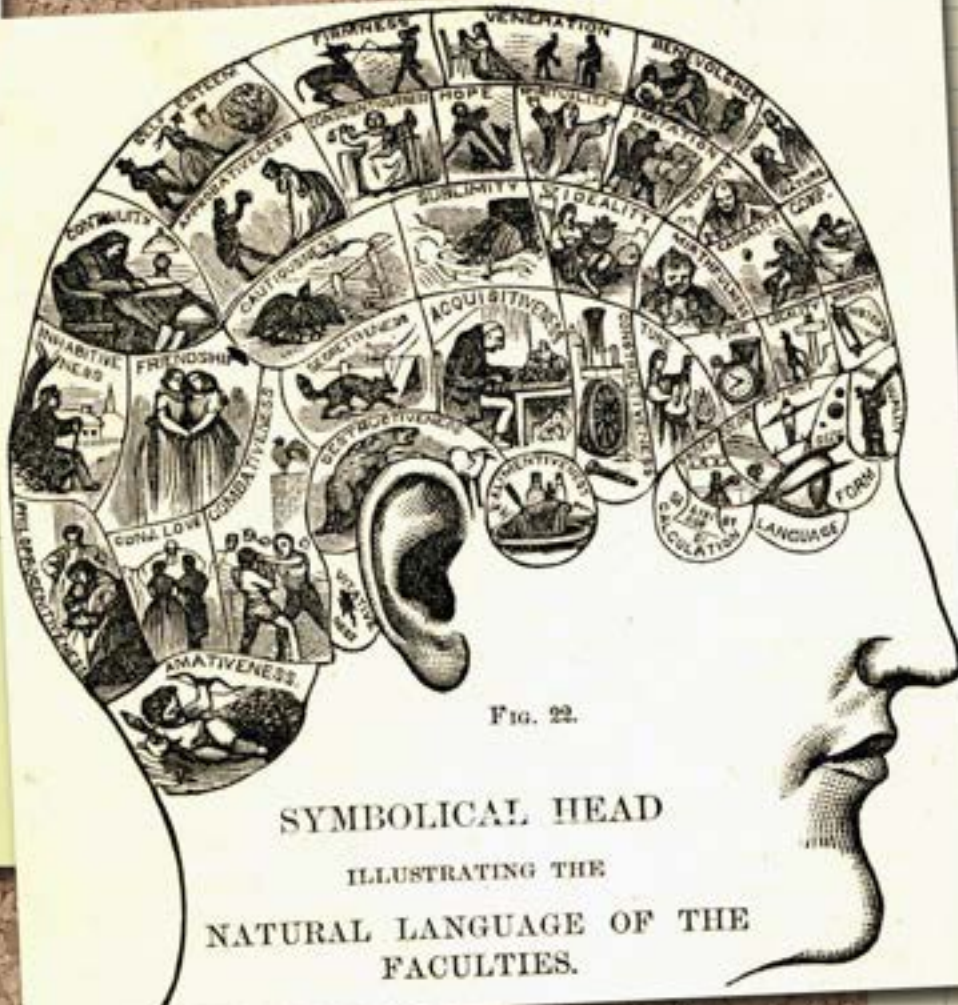
Neuro -

for “neuron,” the nerve cells in the brain and nervous system

Plastic -

for “changeable, malleable, modifiable”

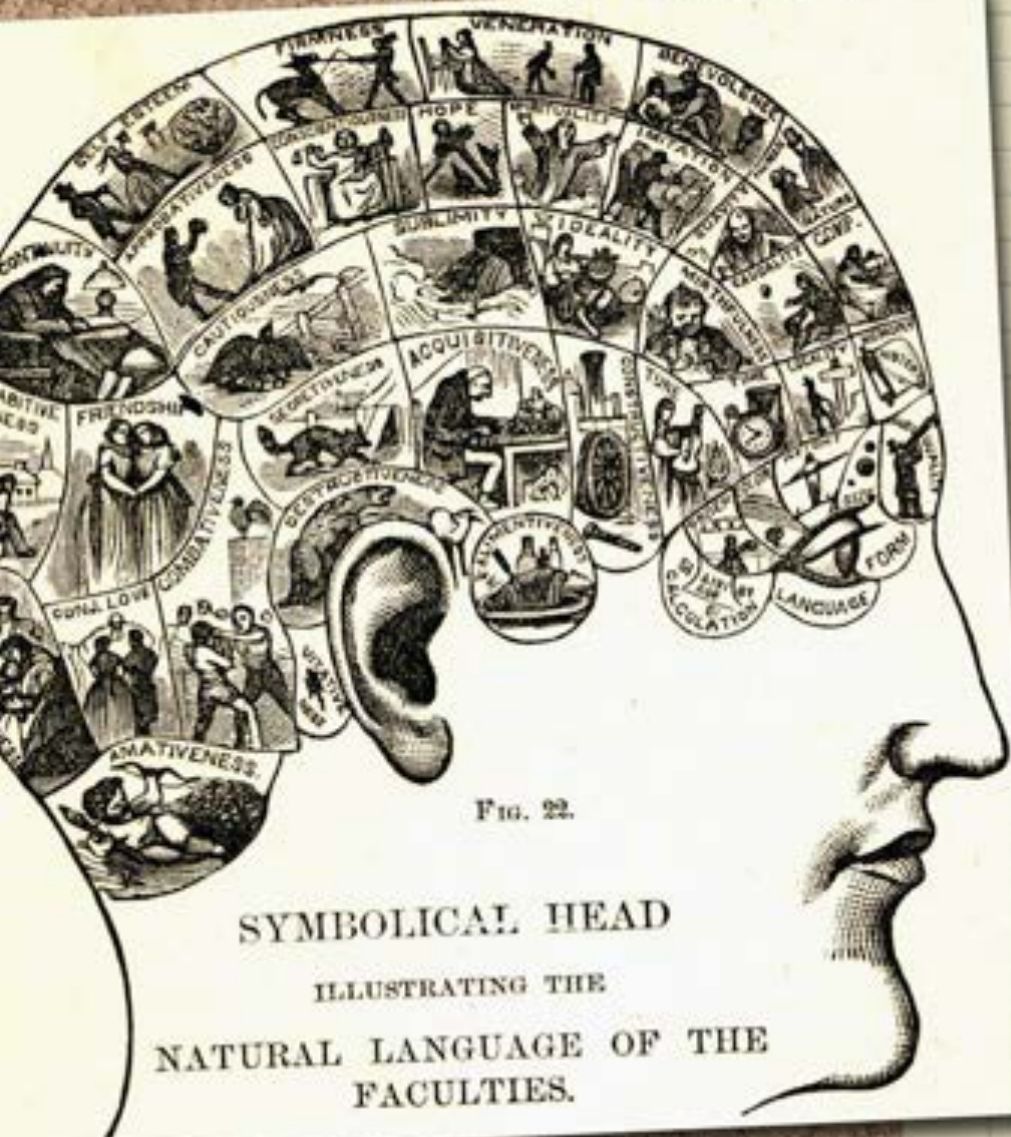




Localization

longstanding idea that the brain is like a **complex machine**, made up of parts, each of which performs a **specific mental function** and exists in a genetically predetermined or **hardwired location**.

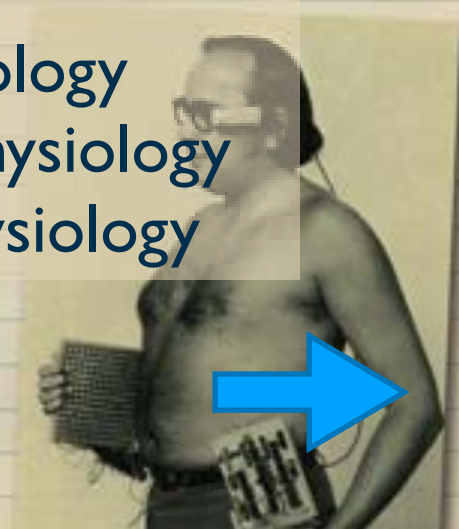




In the late 1960s, a group of scientists began to reject localization-ist claims.

Led by Paul Bach-y-Rita,
trained in:

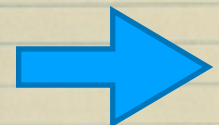
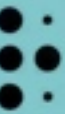
Medicine
Psychopharmacology
Ocular Neurophysiology
Visual Neurophysiology



**Bach-y-Rita's
father Pedro
(professor at
CCNY) had a
disabling stroke
at age 65.**

**After four weeks
of rehab was
pronounced
helpless for life.**

r





Paul's brother George (an MD in Mexico) broke all rules and, learning from babies, taught his father to:

Crawl, walk on knees, stand, and walk.

r



The brain can

r e o r g a n i z e



**itself to acquire new
functions through brain
stimulating exercises.**

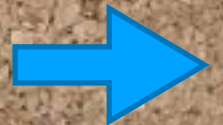
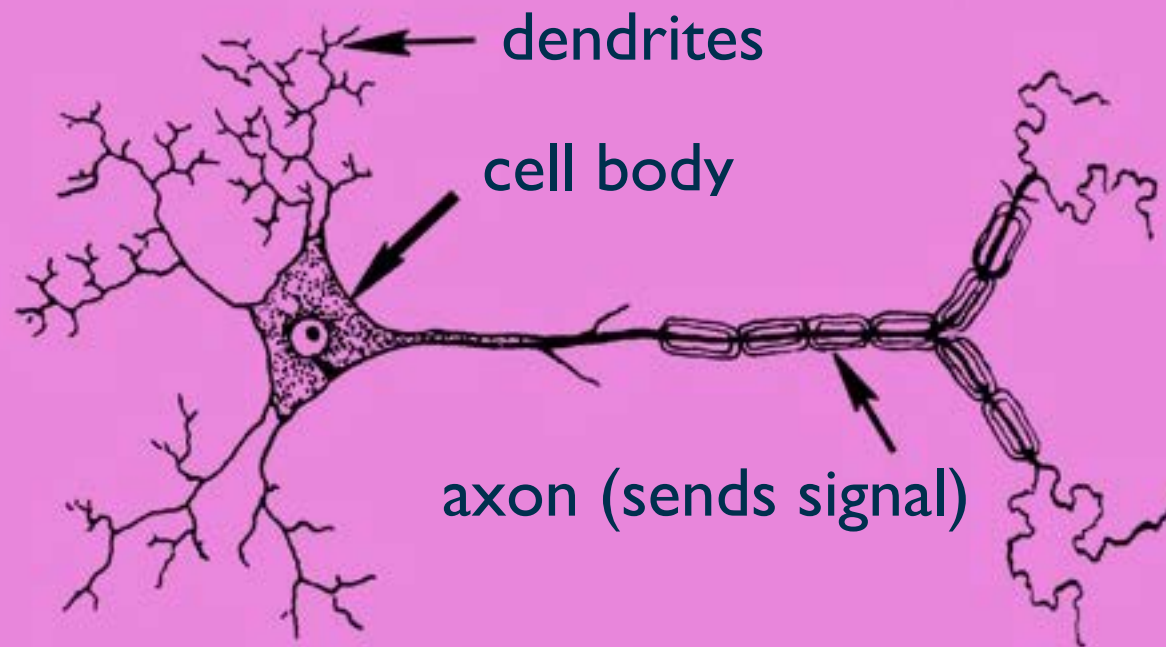


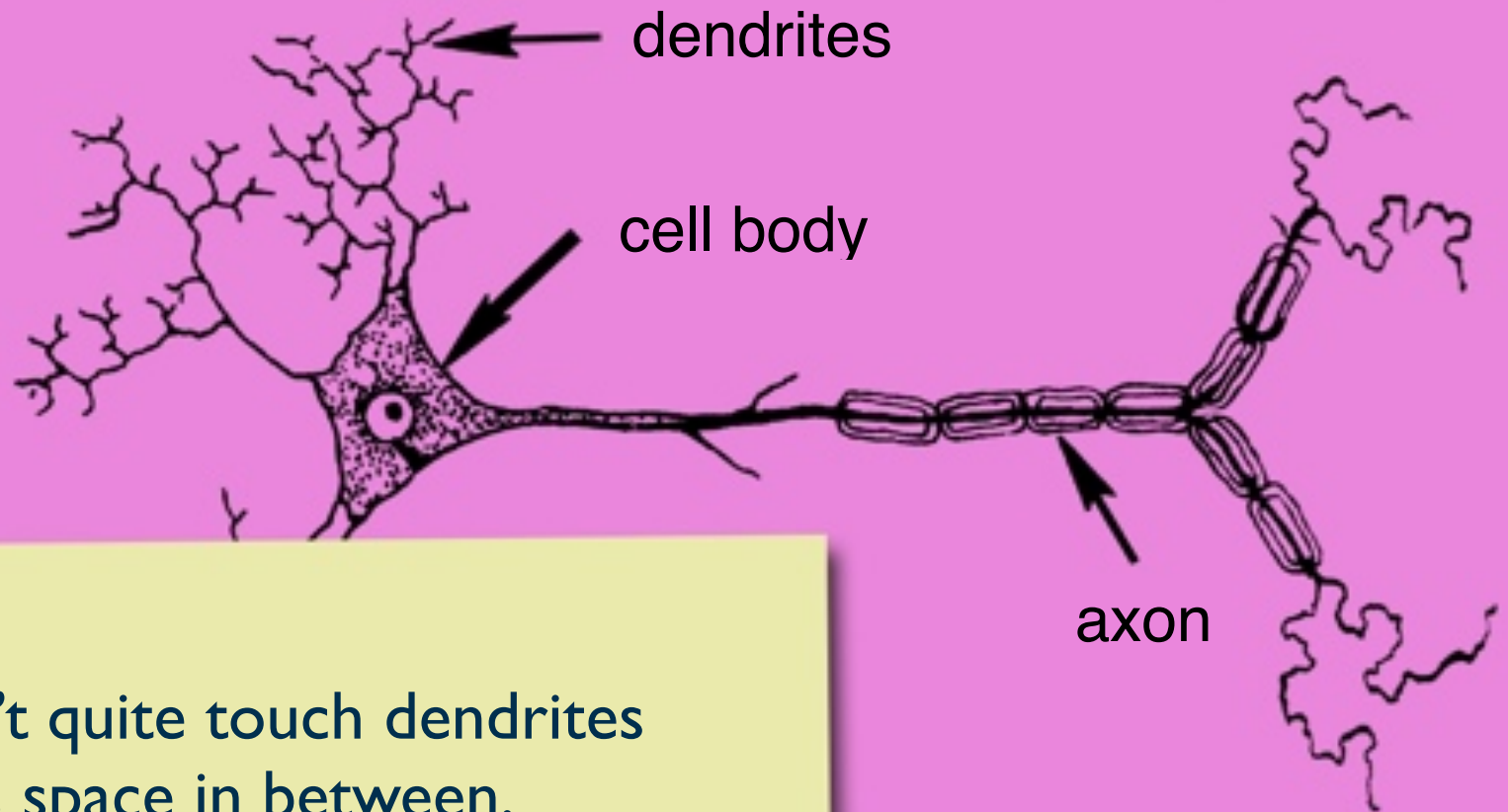
The *visual cortex* in a blind person can be taken over to accept input from *hearing and some touch*.

The *auditory cortex* in a deaf person can be taken over to accept input from your eyes and create superior *peripheral vision*.



Neurons have 3 parts

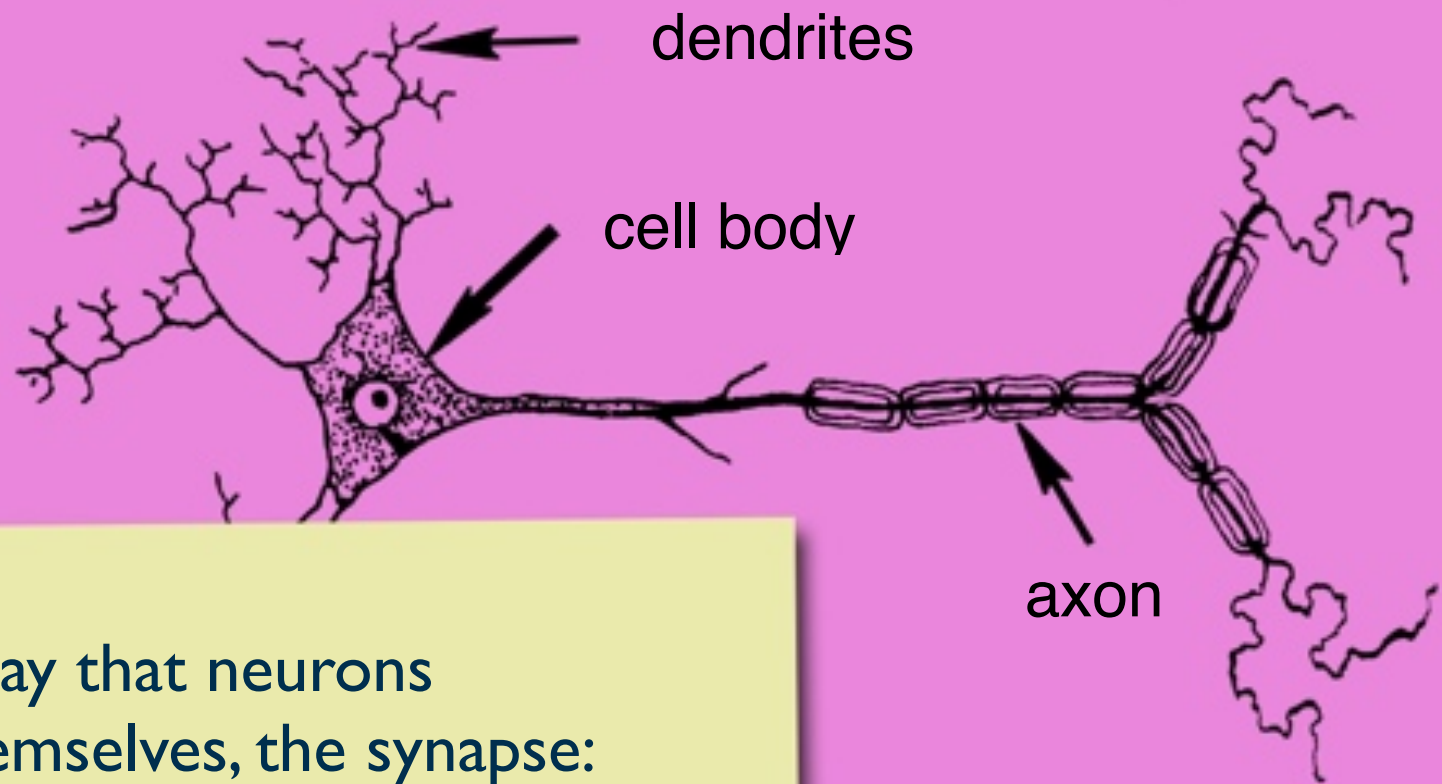




Axons don't quite touch dendrites
- synapse is space in between.

Chemical messengers called
neurotransmitters create the links

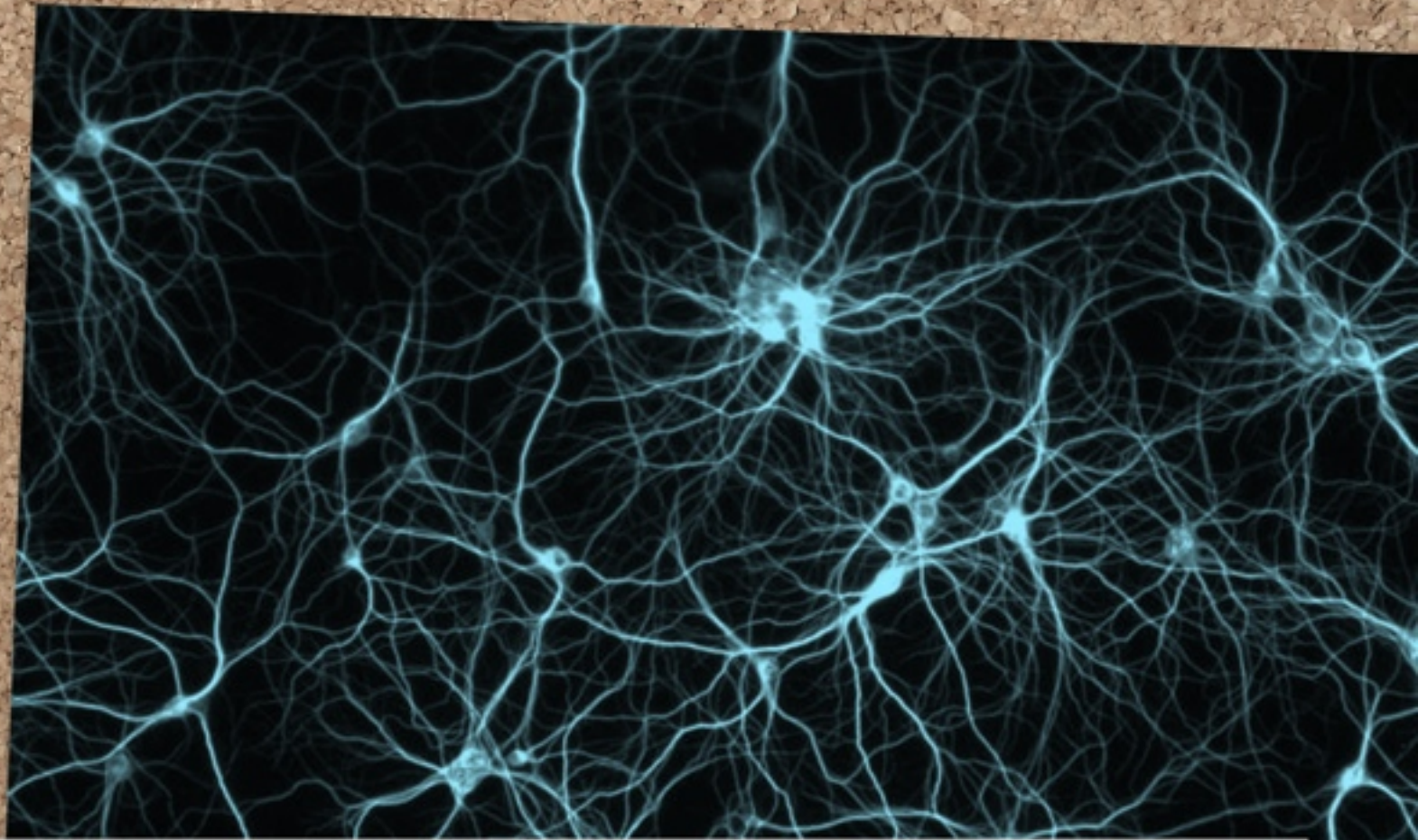




When we say that neurons
“rewire” themselves, the synapse:

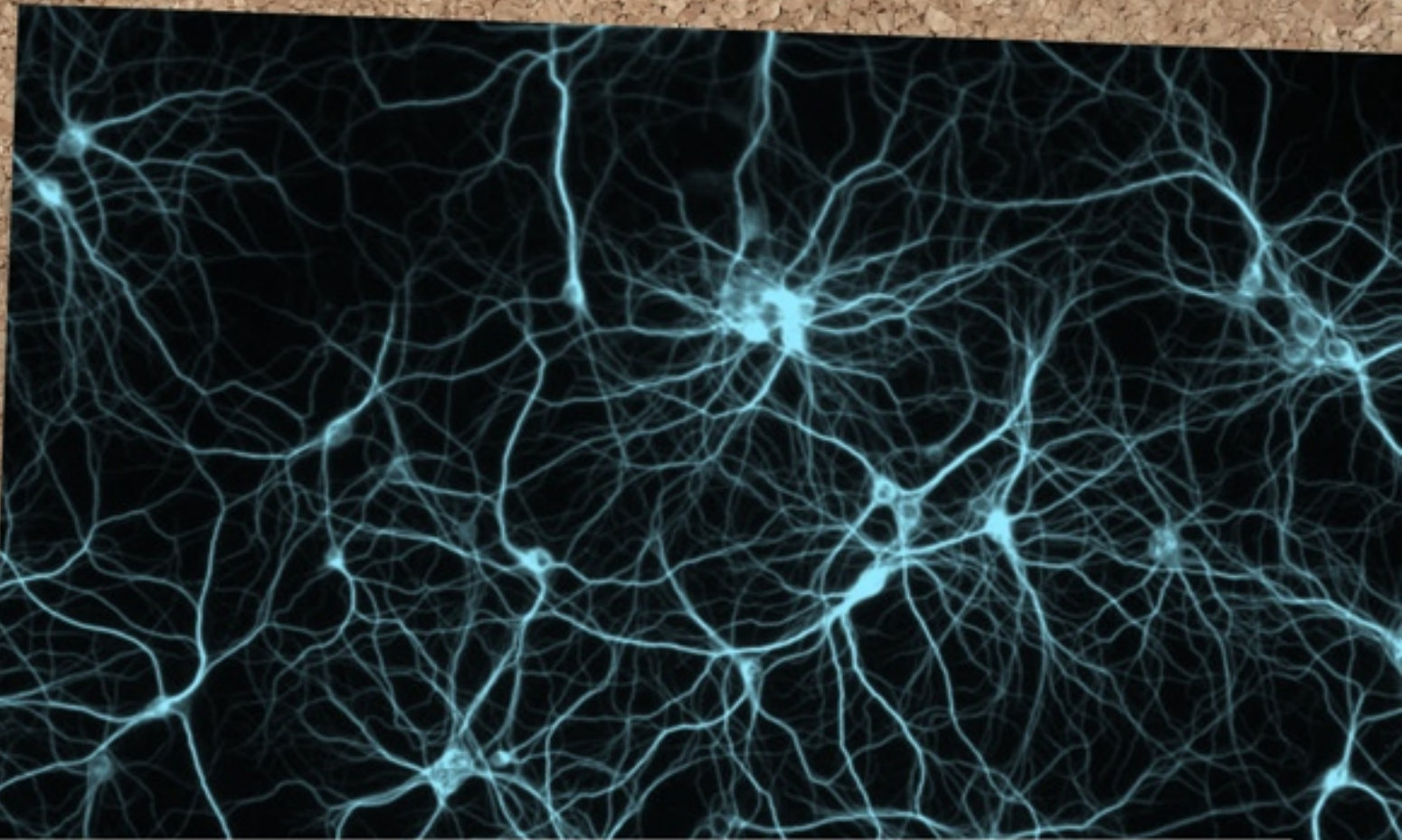
increases **or** decreases the
number of connections between
neurons.





I) Neurons that fire together wire together.



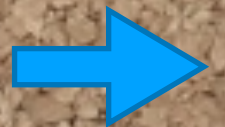


2) Use it or lose it.





Plasticity is greatest in
“critical period” in infancy
and early childhood.





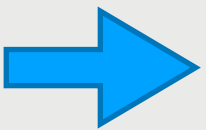
Plasticity is greatest in “critical period” in infancy and early childhood.

But the brain remains plastic throughout life (as evidenced by Paul Bach-y-Rita’s 65 year-old father.)



After critical period
when tasks are
performed automatically,
they change the brain
map but the changes do
not last.

Only when one works
to pay attention does
lasting change occur.

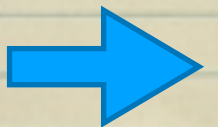


Learning a language in Critical Period is easy because “the learning machinery is constantly on.”

Learning a language later requires intense focus but is good for us because it “**turns on the control system for plasticity**” and keeps it in good shape for laying down sharp memories of all kinds.



Plasticity is enhanced by 3 things:



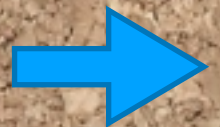
Plasticity is enhanced by 3 things:

1

Intense, sustained mental focus.

Activities performed without paying attention do not create new structure.

Fast pattern of learning (like cramming for a test) can strengthen existing synaptic connections, but do not create new ones.



♩ = 90 by Mark Matthews

mp p mp

5 Two groups learning to play the piano: one, a physical practice group.

p mp 1 2

9 The other, a mental practice group, sat in front of an electric keyboard

mf mp mf 3 2 3 1 2

13 and imagined both playing the sequence and hearing it played

mp mf

17 Mental Practice alone produced the same physical changes in the

f 2 1 3 2 1 2 3 2 1

21 brain as actually playing the piece!

5 3 2 1 2 1



Two groups aiming to strengthen muscles:

1) Physical Group

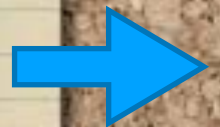
2) Mental Group - imagined doing muscle contraction while also imagining a voice shouting "Harder! Harder!"

Physical group increased muscle strength by 30%

Mental group increased muscle strength by 22%!

30%

22%



Plasticity is enhanced by 3 things:

2

New demands rather than repeating old skills:

- * novel environments trigger neurogenesis
- * must learn something new rather than replaying already mastered skills to improve plasticity.

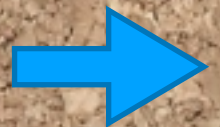


Plasticity is enhanced by 3 things:

3

Physical Activity:

- * increases production of neurons
- * stimulates release of dopamine and serotonin (neurotransmitters)

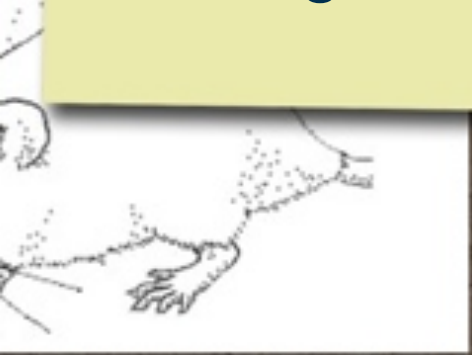
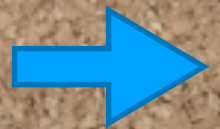


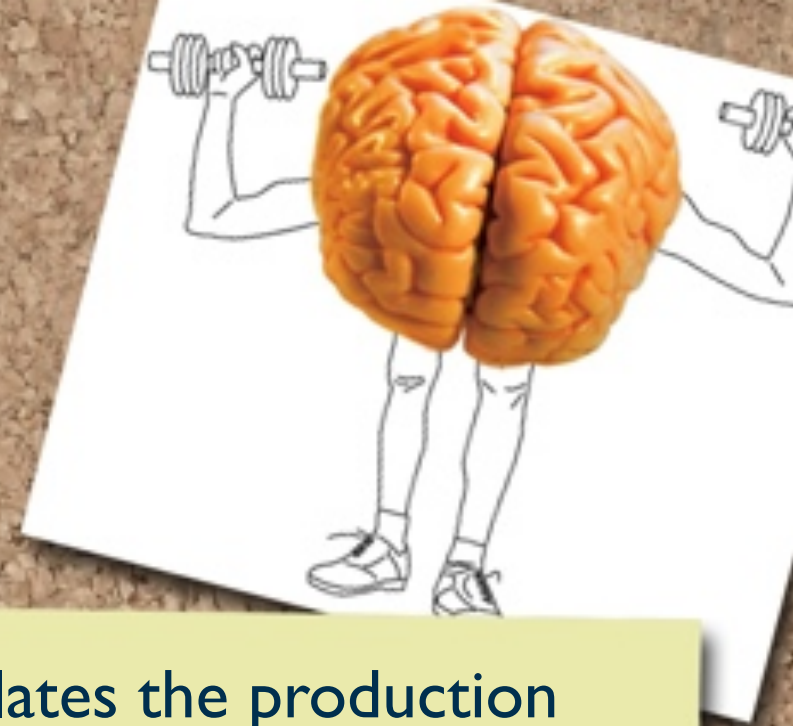
Gerd Kemperman at Salk
Laboratories put aging mice in
a cage with mice toys such as
balls, tubes and running
wheels for 45 days.



After 45 days:

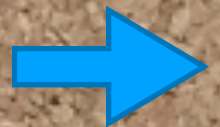
40,000 new neurons (15% increase) compared to mice living in standard cages!



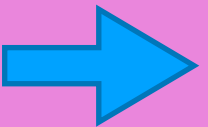
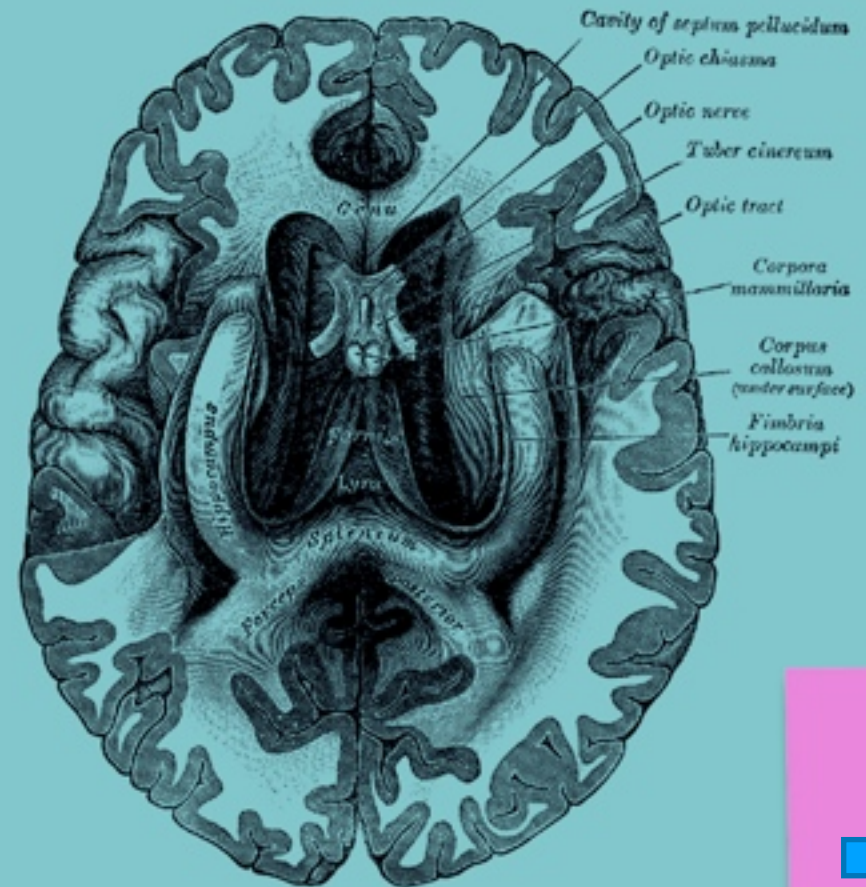


Exercise stimulates the production of the neurological growth factor, “BDNF” —

which plays a crucial role in affecting plastic change.

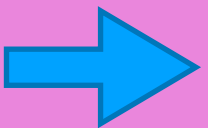
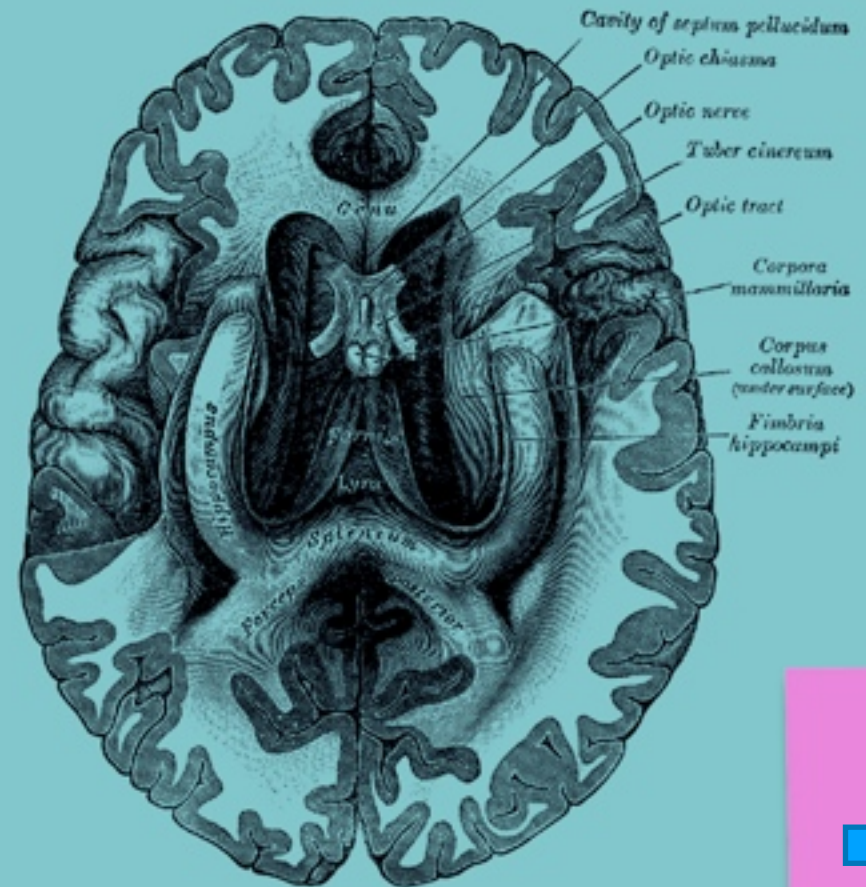


Neuroplasticity applies to many functions of the brain.



Neuroplasticity applies to many functions of the brain.

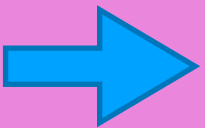
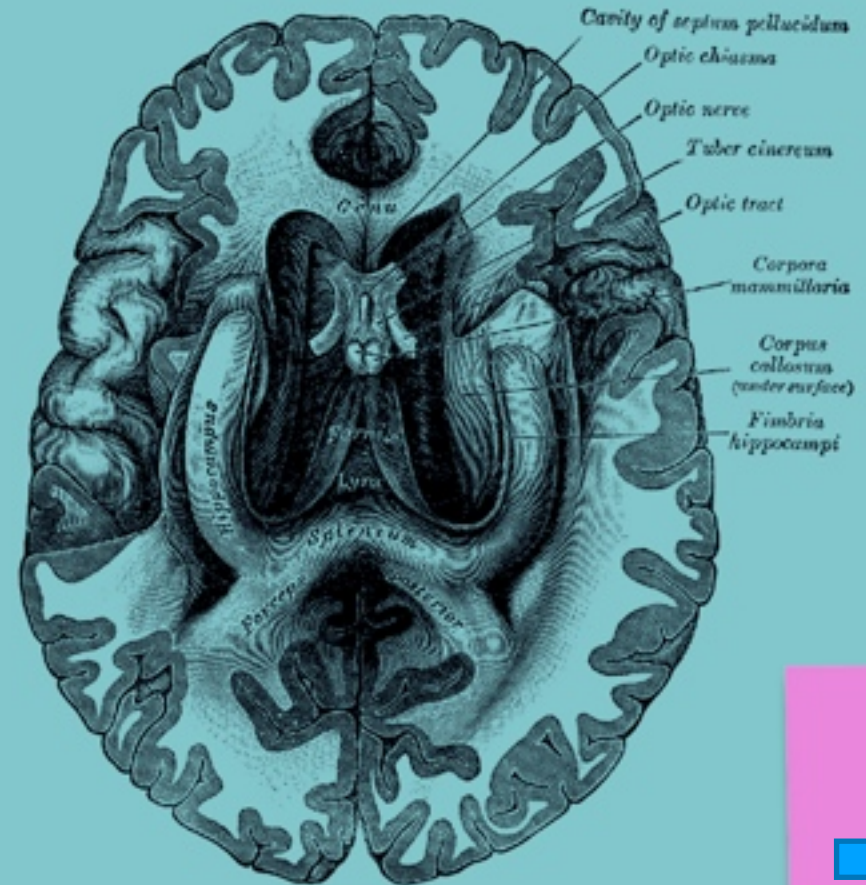
fine motor control



Neuroplasticity applies to many functions of the brain.

fine motor control

gross motor control

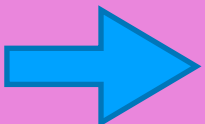
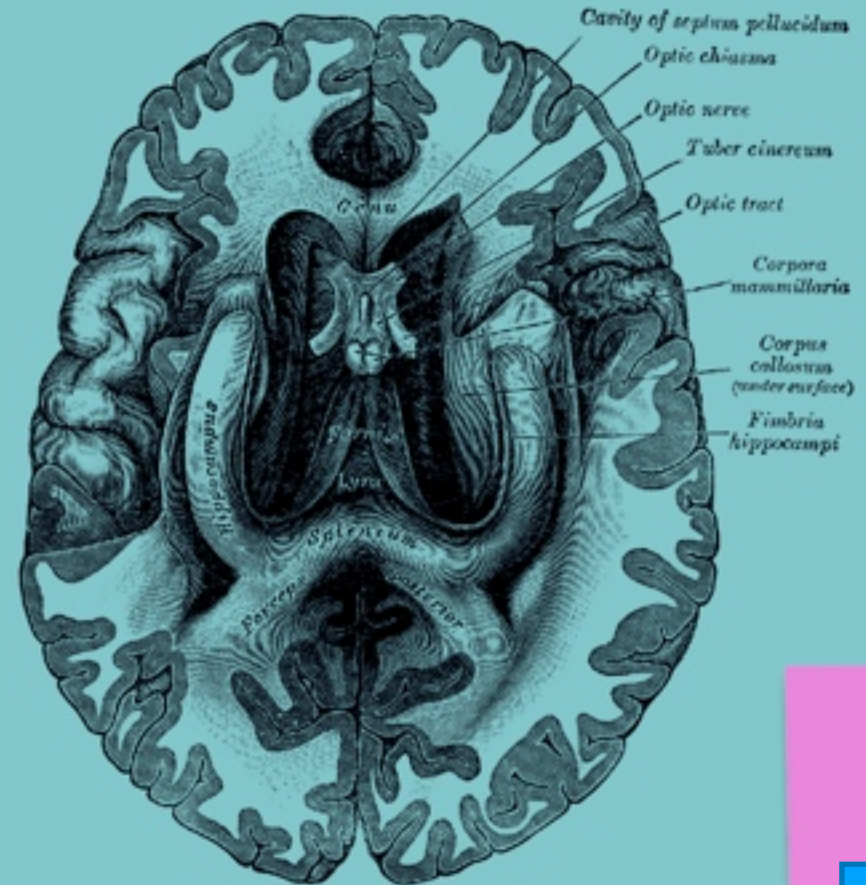


Neuroplasticity applies to many functions of the brain.

fine motor control

gross motor control

emotional bonds



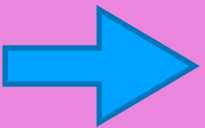
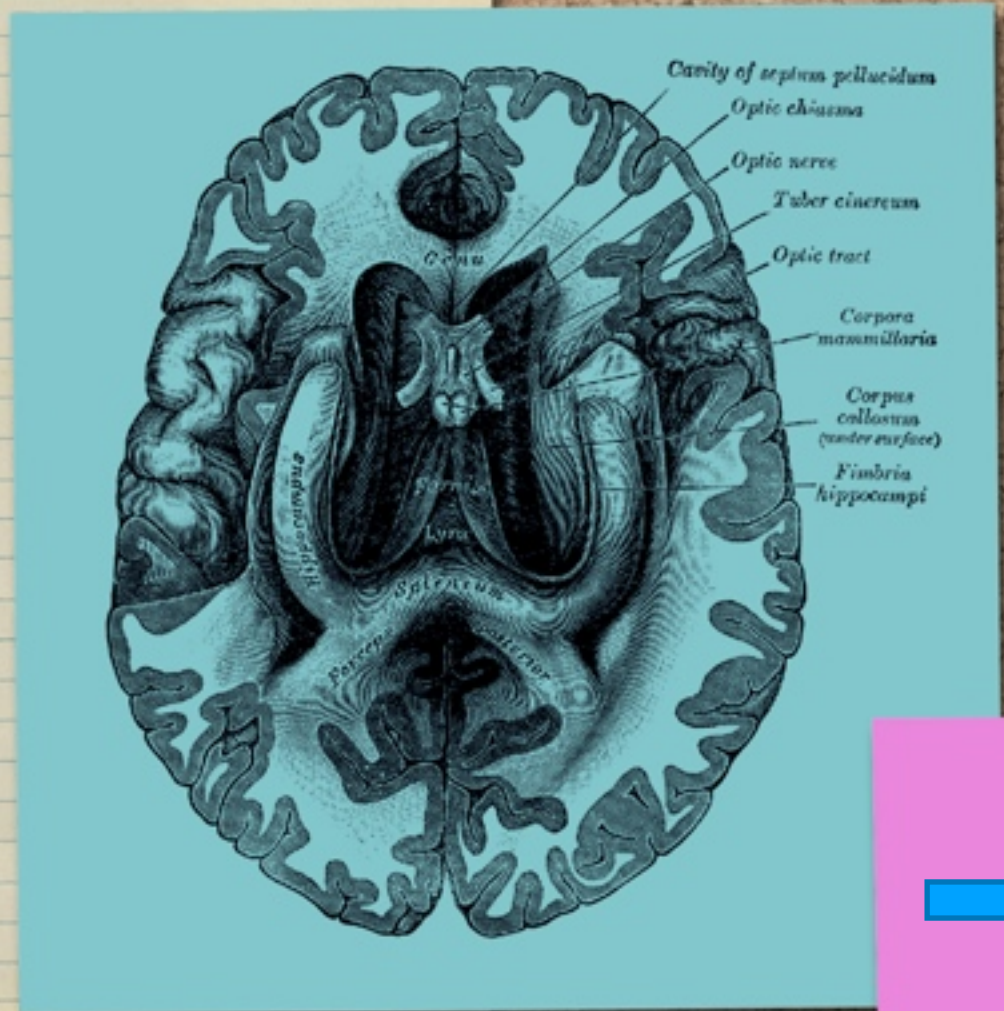
Neuroplasticity applies to many functions of the brain.

fine motor control

gross motor control

emotional bonds

sense of balance



Neuroplasticity applies to many functions of the brain.

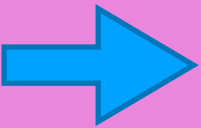
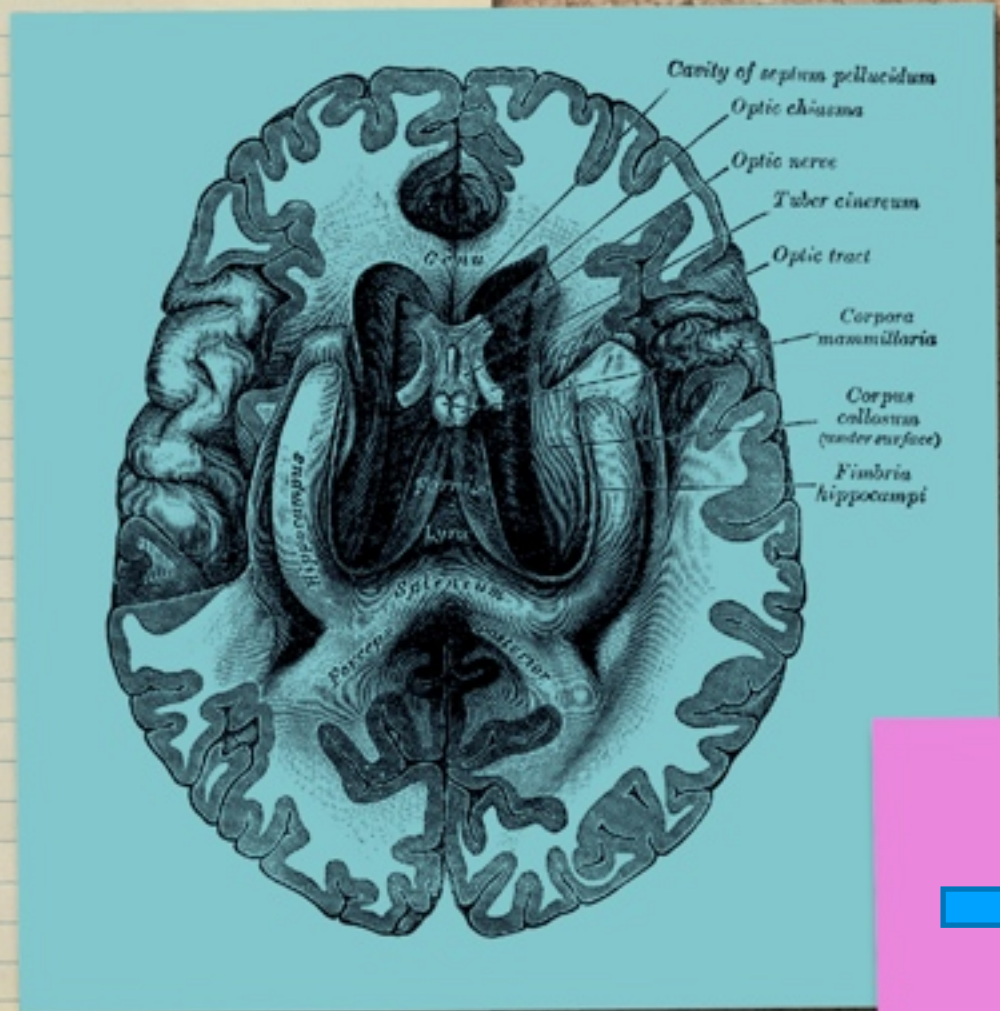
fine motor control

gross motor control

emotional bonds

sense of balance

instinctive behavior (like sex)



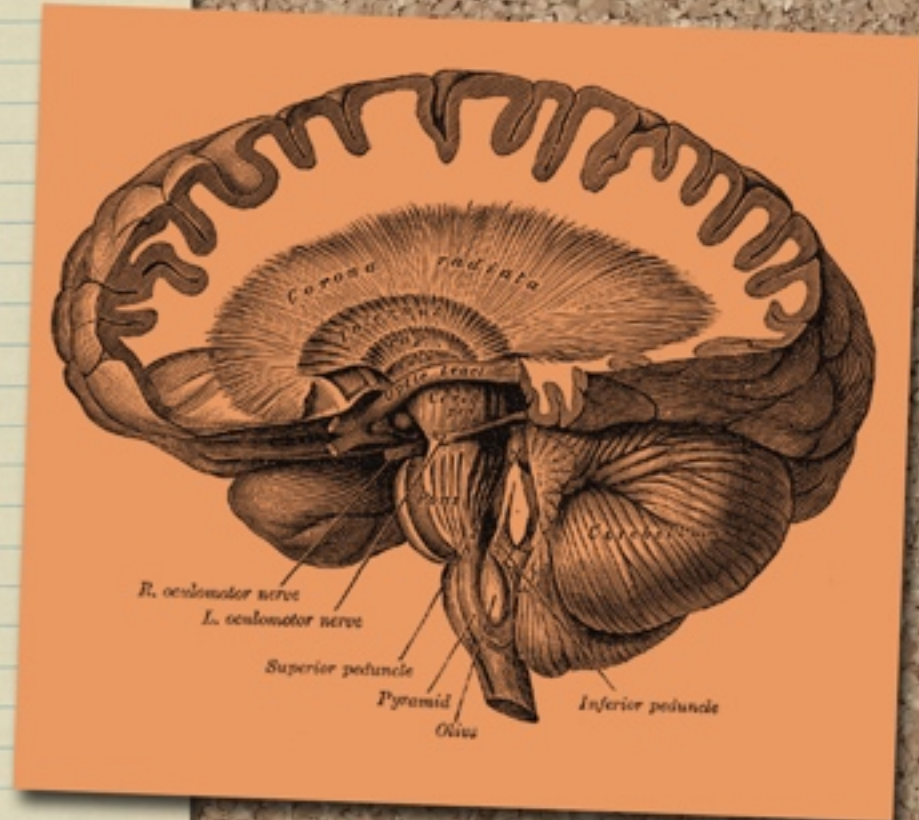


Neuroplasticity applies equally to the frontal lobes that support creative thinking.



Neuroplasticity even allows one hemisphere of the brain to compensate for a weakness in the other by taking over some of its functions

“mirror region takeover.”





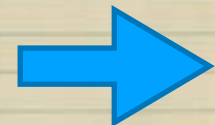
Paul:

7-month-old whose right parietal lobe was destroyed in a car accident.

At 17, Paul was having problems with math

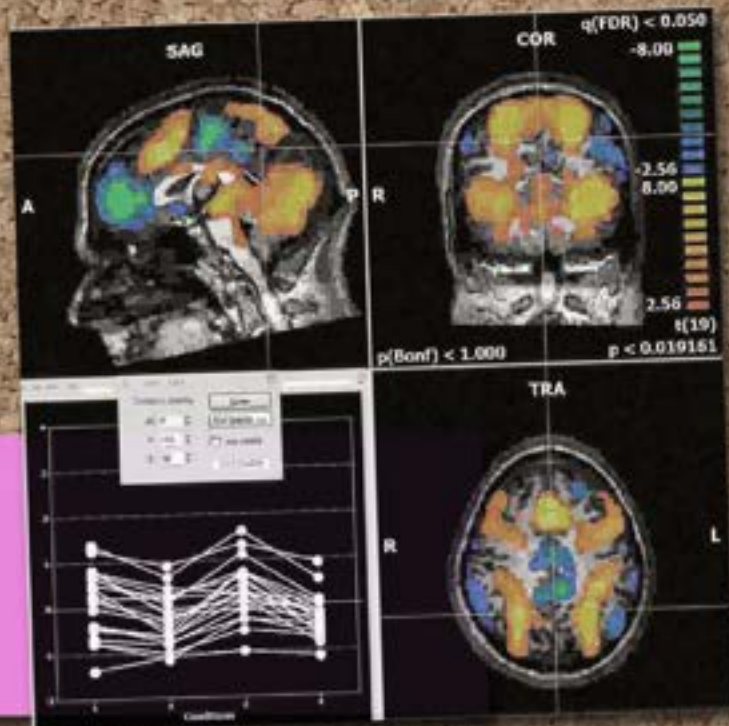
(which should have been dealt with in left, not right hemisphere)

EX #1

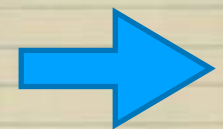




FMRI showed left lobe was now processing visual spatial information leaving no room to process math.



Accident occurred **before** stage of development where left lobe would have been needed for calculation.



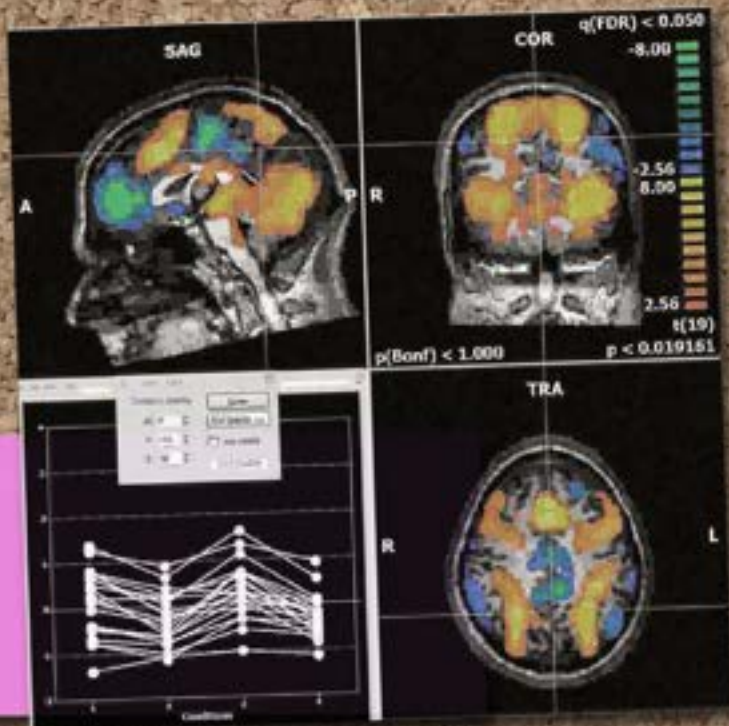
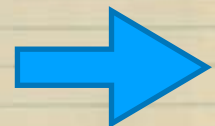


Prior to 6-years-old
(before “learning”
math) visual /spatial
activity found a new
home:

instead of the **right**
parietal lobe

it moved to the **left**
parietal lobe

allowing Paul to learn
to navigate the world.





Michelle had damaged **left** frontal lobe from birth.

left frontal lobe: stores memories of individual events.

right frontal lobe: extracts theme or main point from a series of events

Frontal lobes together are the part of the brain that is most uniquely human.

They are most developed in humans relative to other animals.



#2

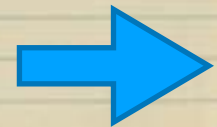


Michelle has same **mirror area adaption** as Paul, but in frontal lobes.

Ability to remember individual events was an earlier developmental need.

It found its home in a functioning part of the brain, (right instead of left)

but replaced activities that would otherwise occur there.





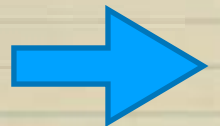
Michelle has difficulty with:

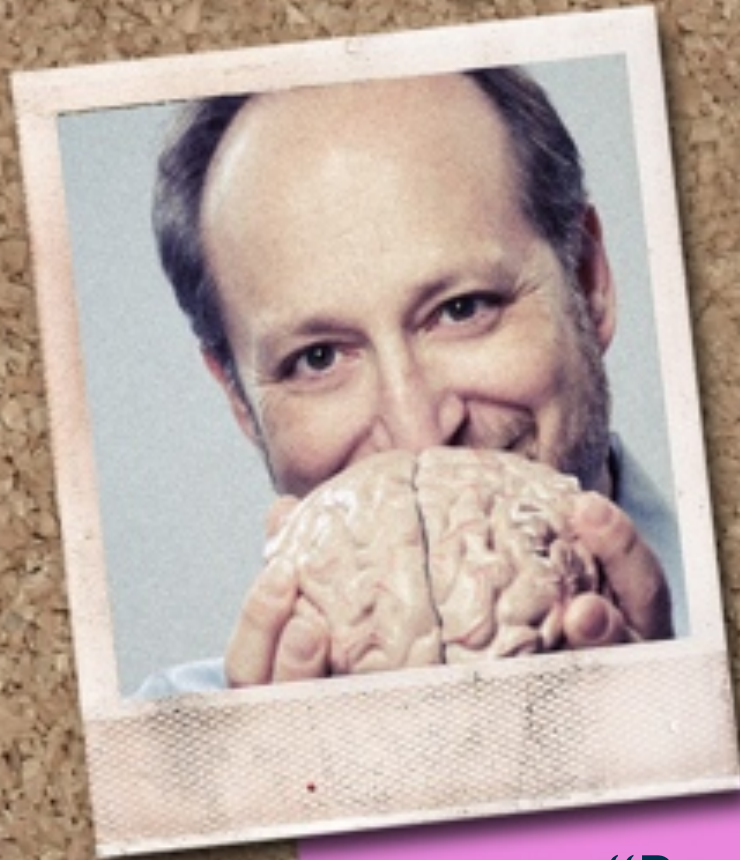
- getting the **main point**
- understanding **metaphors** and concepts
- **abstract** thought
- planning
- envisioning the **future**

But has a savant's ability to:

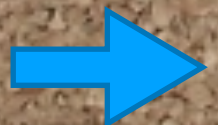
- remember **individual** events
- know **exact dates** and times
- **memorize** cards (she is whiz at solitaire)

but why?





“People without disabilities can benefit from liberating one hemisphere from another” — Norman Doidge



“Whole cultures encourage development of certain neuronal maps by the experience it offers its members and the skills it demands of them.”

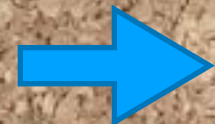
The Culturally Modified Brain





Historical Perspective:

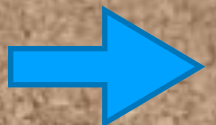
movement from
“organizational age”
to a “creative age”



How does our culture help
to articulate **our brain
map** in a creative age?

Richard Florida argues:

- capacity for personal expression
- freedom to shape our jobs
- flexible time
- flat organization
- personal motivation





How do we (as individuals)
generate our own brain
maps to improve creative
problem solving ability?

* Experiential Life

* Csizentmihali's
Four Step Recipe

* Self-Education



Twitter Card Question:

What is one small thing I can do in terms of lifestyle/daily activities to increase the action of my frontal lobe and make me better at creative problem solving?

