BRAIN TRAINING: THE NEW SCIENCE OF INTELLIGENCE
We used to think that brains were a lot like skeletal structures:

- You’re born with everything you’ll ever have.
- No matter what you do, nothing new is added over time.
Brains are a lot like muscles:

• What you’re born with is just a start

• What you do makes a big difference in how your muscles and brain grow and develop!
There are four important ways that muscles and brains are alike.
SIMILARITY #1

- Muscles and brains have tiny structures that grow and multiply.
MUSCLES HAVE FIBERS...

- that contract when the muscle is put to work.

- Your muscles grow as the fibers get bigger new fibers are added.
BRAINS HAVE NEURONS...

• that are activated when the brain is in use.

• Your brain grows as neurons get denser and new neurons are added.
WHAT’S A NEURON?

- The brain is made up of billions of neurons that work together to run our bodies and our minds.

- 30,000 neurons can fit on the head of a pin.

- Neurons are cells that share information with each other.
Neurons communicate by passing along an electrical impulse.

Electrical impulses are passed from one neuron to the next through the release of chemicals called neurotransmitters.
HOW DO NEURONS GET DENSER WITH USE?

- Under heavy use, neurons develop new dendrites so that they can communicate more efficiently with each other.
• The human brain constantly generates *progenitor* cells that can turn into neurons.

• A brain that is learning needs to add neurons to store and communicate the new information.

• This process by which a progenitor cell becomes a neuron is called *neurogenesis*. 
HOW DO WE KNOW THAT BRAINS GROW AS WE LEARN?

• Animal studies prove that the brain grows when challenged.

• Rats raised in enriched cages have brains that are 10% heavier than the brains of rats raised in plain cages.
• Muscles and brains only develop when challenged by increasingly difficult tasks.
TO DEVELOP BIGGER MUSCLES...

- You need to lift heavier and heavier weights.
TO DEVELOP YOUR BRAIN...

• You need to do harder and harder work.
Developing muscles & developing your brain is challenging and sometimes uncomfortable.
MUSCLES ONLY DEVELOP...

- When pushed past the point of comfort.
BRAINS ONLY DEVELOP...

- When pushed past the point of comfort.
SIMILARITY #3

• Building muscles and building your brain takes time and sustained effort.
SUSTAINED EFFORT IS REQUIRED...

• to build new connections between neurons and

• to integrate new neurons into old neural pathways.
HOW DO WE KNOW THAT SUSTAINED EFFORT BUILDS YOUR BRAIN?

- Buddhist monks spend thousands of hours engaged in meditation, the art of carefully observing one’s own mental processes.

- Areas of the brain associated with attention and sensory processing are much thicker in the brains of monks than in the brains of people who don’t meditate.
SIMILARITY #4

• *All* girls can build their muscles and their brains.
MUSCLES AND BRAINS START SMALL IN EVERYONE AND GROW WITH USE.
BABIES’ MUSCLES START SMALL AND WEAK AND GET BIGGER AND STRONGER WITH USE.
BRAINS BECOME DENSER AND MORE COMPLEX AS NEW MENTAL SKILLS ARE DEVELOPED
BUILDING MUSCLE...

- makes you stronger!

- Your new muscles can help you do all sorts of things.
BUILDING YOUR BRAIN...

• makes you smarter!

• Your increased intelligence can help you in all of your classes.
How are muscles & brains alike?

• Both have tiny structures that GROW AND MULTIPLY.

• These structures only develop when CHALLENGED by difficult tasks.

• Both muscles and brains require SUSTAINED EFFORT in order to develop.

• ALL GIRLS can build their muscles AND their brains.