

# The Art of Changing the Brain

Enriching teaching by exploring the  
biology of learning

James E. Zull

Publisher: Stylus, Arlington, VA  
Available at: Amazon.com (best price!)

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## Four major functions of brain



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## FOUR PILLARS OF LEARNING

- GET INFORMATION (SENSORY)
- MAKE MEANING (BACK INTEGRATIVE)
- CREATE YOUR OWN IDEA (FRONT INTEGRATIVE)
- ACT-TRY OUT IDEAS, SOLUTIONS (MOTOR)
- ATTEND TO OUTCOMES (SENSE, GET NEW INFORMATION)

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## **FOUR PILLARS OF LEARNING**

- GET INFORMATION (SENSORY)

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## **FOUR PILLARS OF LEARNING**

- GET INFORMATION (SENSORY)
- MAKE MEANING (BACK INTEGRATIVE)

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## **FOUR PILLARS OF LEARNING**

- GET INFORMATION (SENSORY)
- MAKE MEANING (BACK INTEGRATIVE)
- CREATE YOUR OWN IDEA (FRONT INTEGRATIVE)

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## FOUR PILLARS OF LEARNING

- GET INFORMATION (SENSORY)
- MAKE MEANING (BACK INTEGRATIVE)
- CREATE YOUR OWN IDEA (FRONT INTEGRATIVE)
- ACT-TRY OUT IDEAS, SOLUTIONS (MOTOR)

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## FOUR PILLARS OF LEARNING

- GET INFORMATION (SENSORY)
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- CREATE YOUR OWN IDEA (FRONT INTEGRATIVE)
- ACT-TRY OUT IDEAS, SOLUTIONS (MOTOR)
- ATTEND TO OUTCOMES (SENSE, GET NEW INFORMATION)

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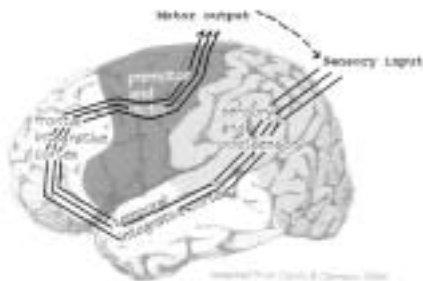
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## Flow of signaling in cortex



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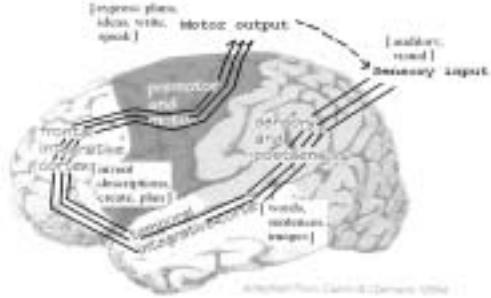
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### Brain's language cycle



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### THE ART-PART I

**USE THE FOUR PILLARS-  
ALL OF THEM!**

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**EMOTION, BRAIN,  
LEARNING, MOTIVATION**

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**EMOTION, BRAIN,  
LEARNING, MOTIVATION**

1. The biochemistry of emotion (dopamine, serotonin, adrenalin, endorphins)is required for learning

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**EMOTION, BRAIN,  
LEARNING, MOTIVATION**

1. The biochemistry of emotion (dopamine, serotonin, adrenalin, endorphins)is required for learning
2. Brain evolved as an organ of emotion

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**EMOTION, BRAIN,  
LEARNING, MOTIVATION**

1. The biochemistry of emotion (dopamine, serotonin, adrenalin, endorphins)is required for learning
2. Brain evolved as an organ of emotion
3. Understanding brain emotion systems helps us understand motivation

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**AMYGDALA-CORTEX CROSSTALK-  
EMOTION TO INTEGRATION (AND  
VICE VERSA)**



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**FEAR-FROM THE PLUS TO  
THE MINUS**

ATTENTION  
ENERGY  
REMEMBER CLEARLY  
STRESS  
CAN'T THINK  
DAMAGE MEMORY

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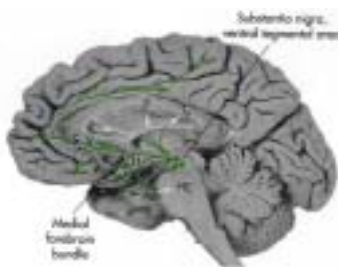
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**DOPAMINE PATHS-REWARD  
IN THE FRONT**



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**THE ART-PART II**

**ASK "HOW DOES THE STUDENT FEEL?"**

**ENGAGE FRONT CORTEX-  
STUDENT SHOULD TAKE OWNERSHIP**

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**WHAT IS KNOWLEDGE? HOW DOES IT CHANGE?**

**THE THIRD PRINCIPLE FOR CHANGING THE BRAIN**

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## Brain networks change



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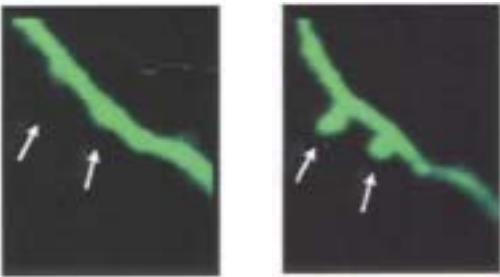
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## Neuron firing generates branching



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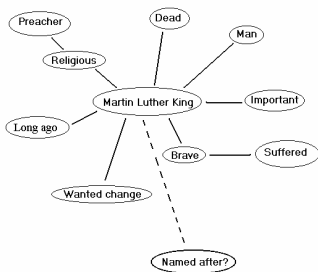
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## Building on old networks



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## THE ART- PART III

Begin with student knowledge

Build on what is useful

Ignore what is not useful

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## WHAT IS THE ART?

- 1. Use all four major functions of brain**
- 2. Ask “how do my students feel?”**
- 3. Work from existing networks of neurons**
- 4. Balance all these**

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