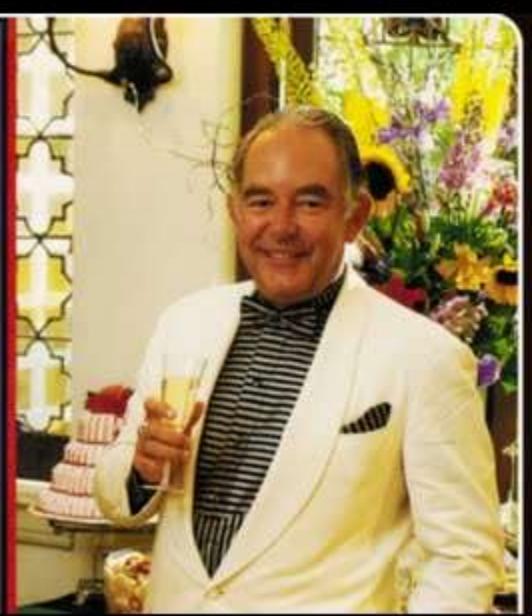


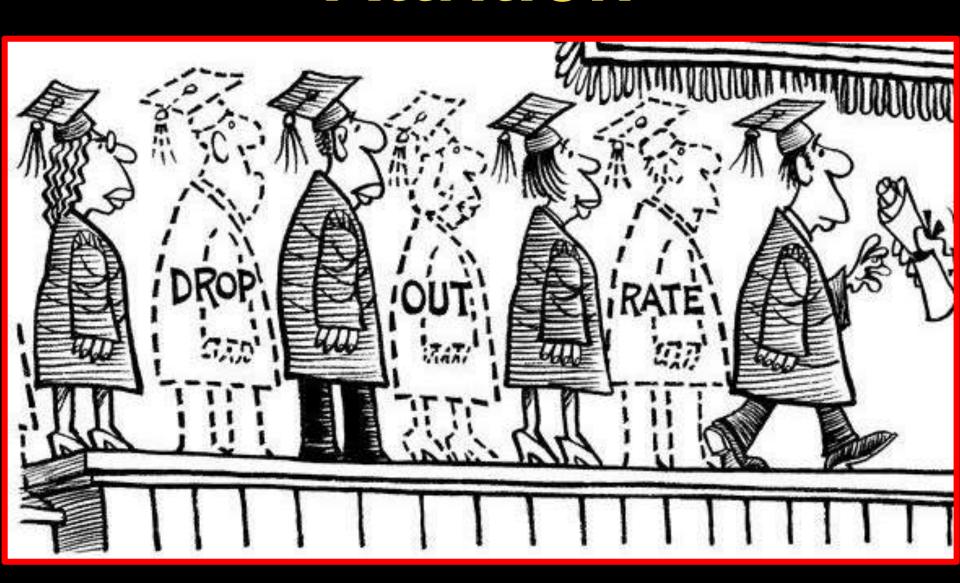
KICH and FAMOUS

Robin Leach





Attrition



Gender Imbalance



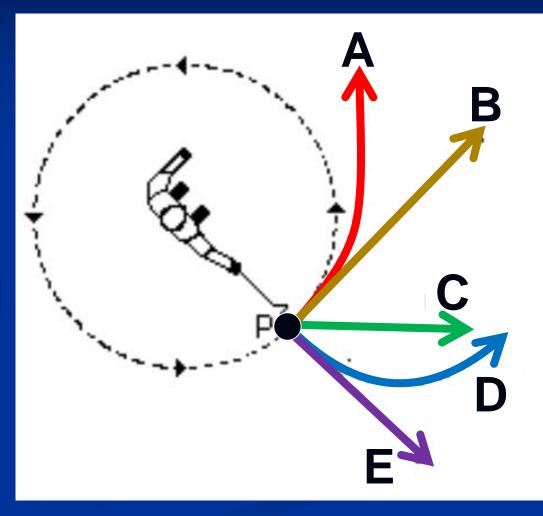


Force Concept Inventory

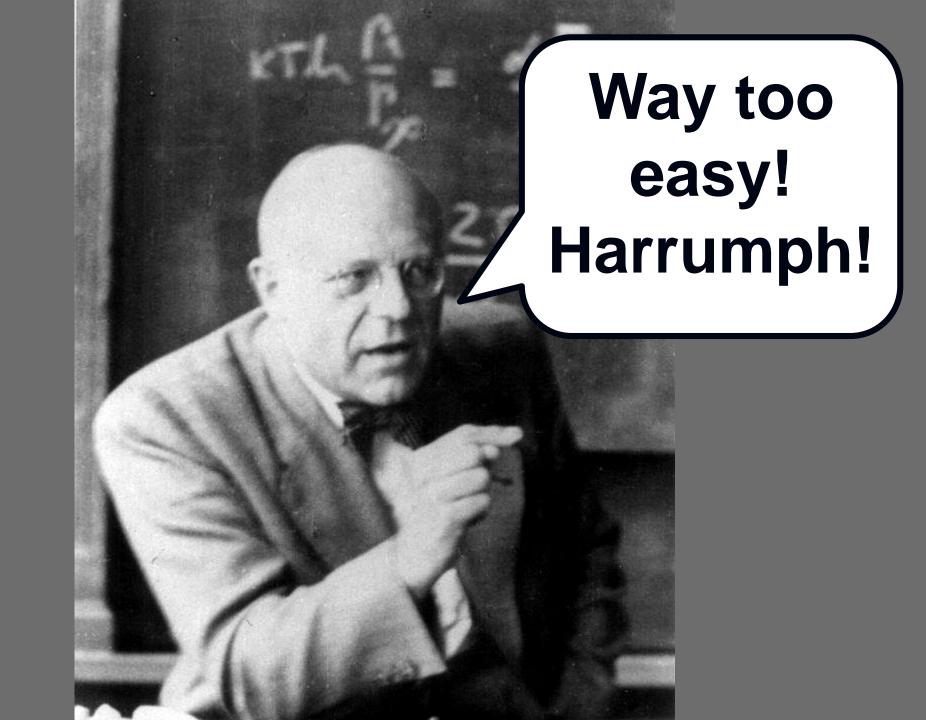
A ball on a string is swung in a horizontal circle.

At point P, the string breaks.

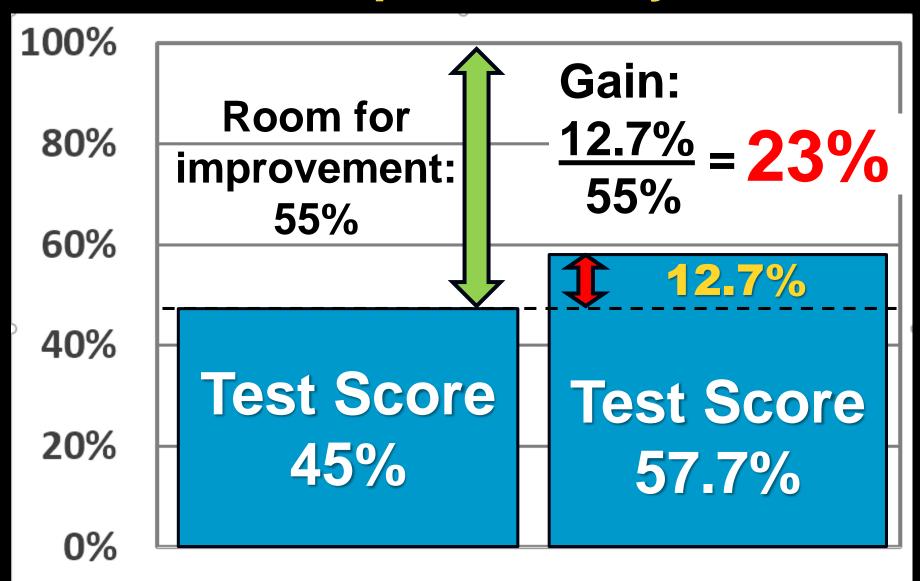
Which path would the ball most closely follow, observed from above?



Hestenes, D., Wells, M., & Swackhamer, G. (1992). Force concept inventory. *The physics teacher*, *30*(3), 141-158.



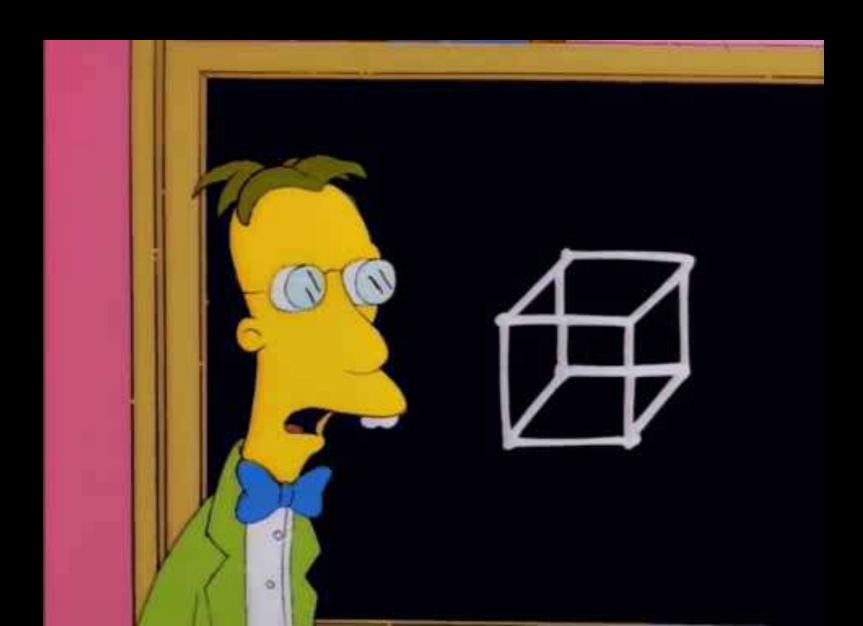
Force Concept Inventory Scores



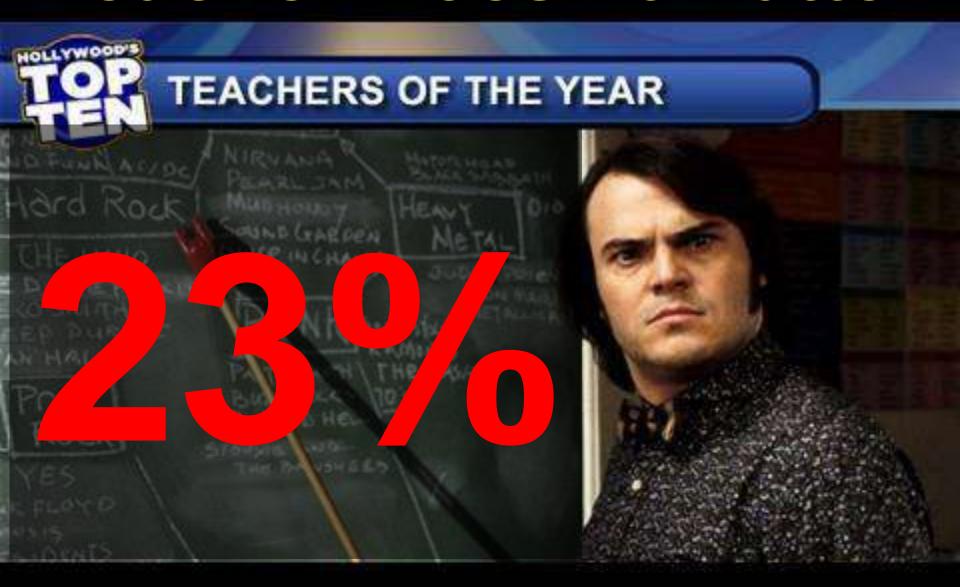
Start of Course

End of Course

Teacher Doesn't Matter



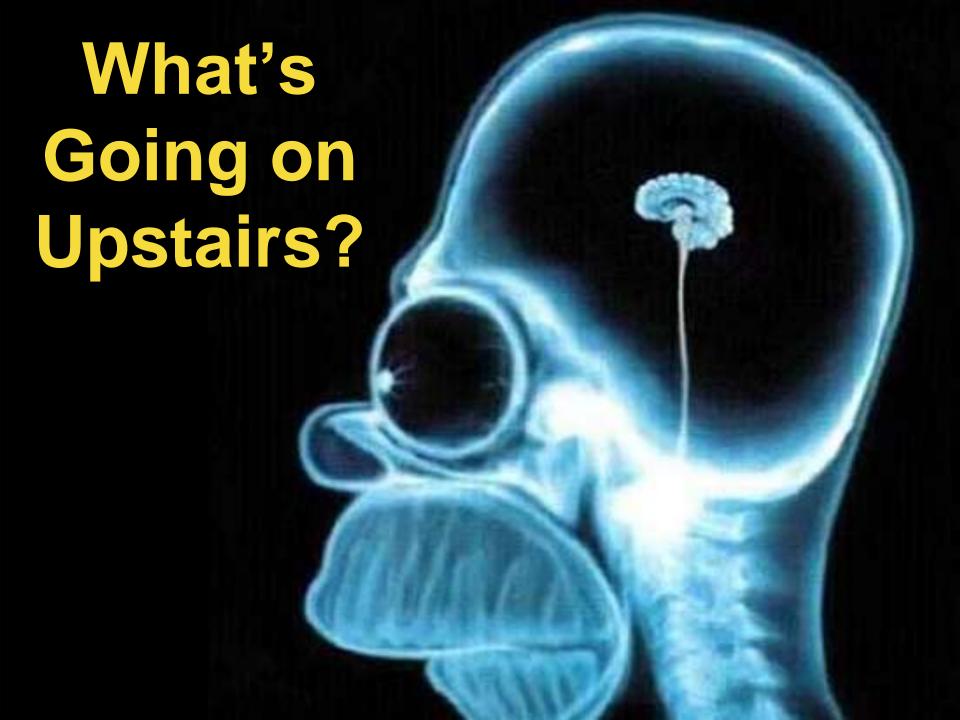
Teacher Doesn't Matter



Best Lesson Ever







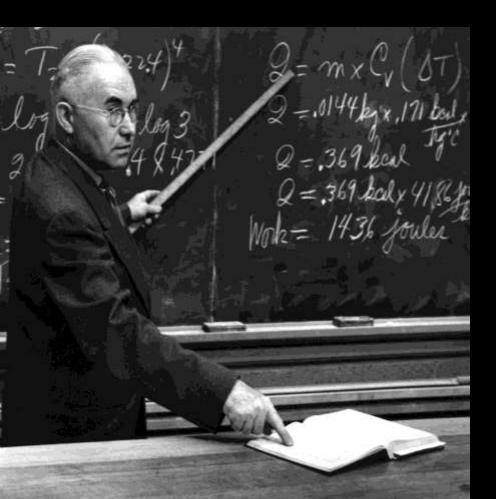


Why aren't my students doing their job: learning?

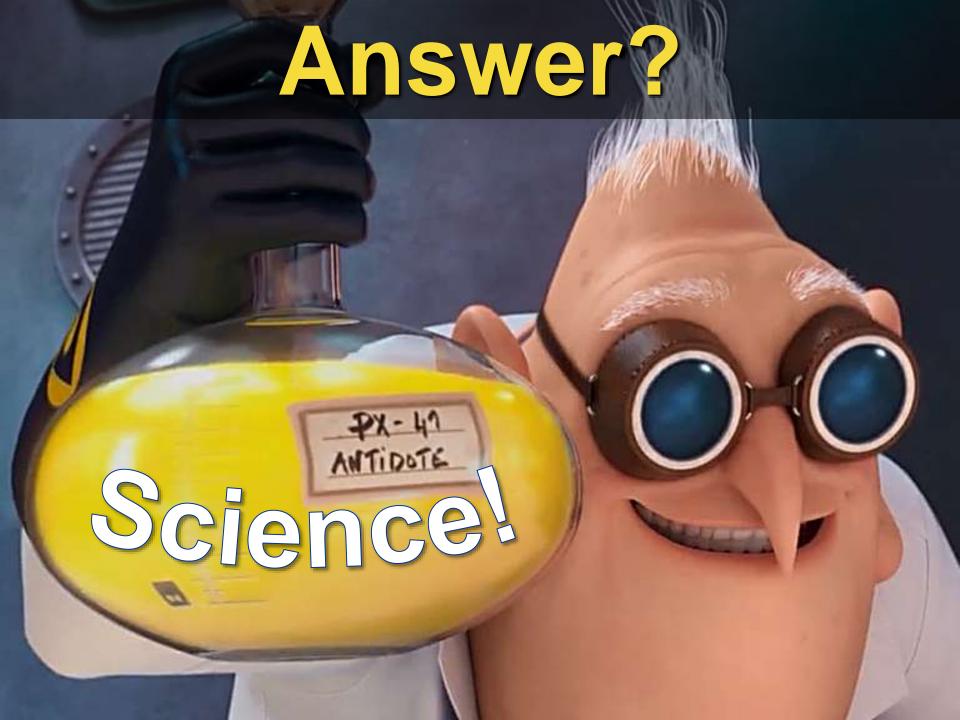
The Measure of Teaching?

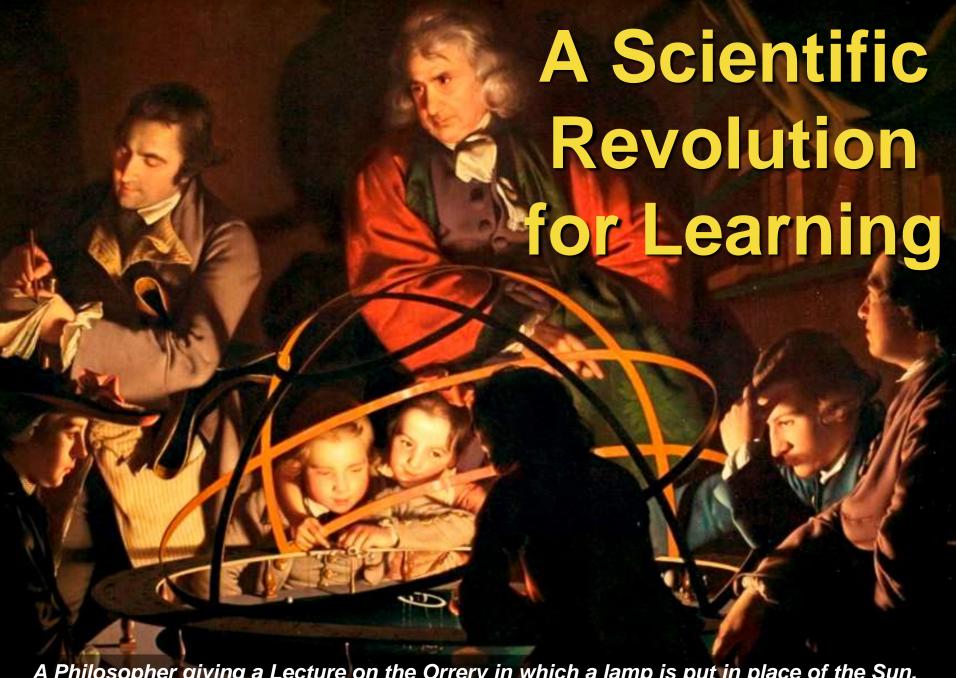
How well is the material presented? students learning?

How well are





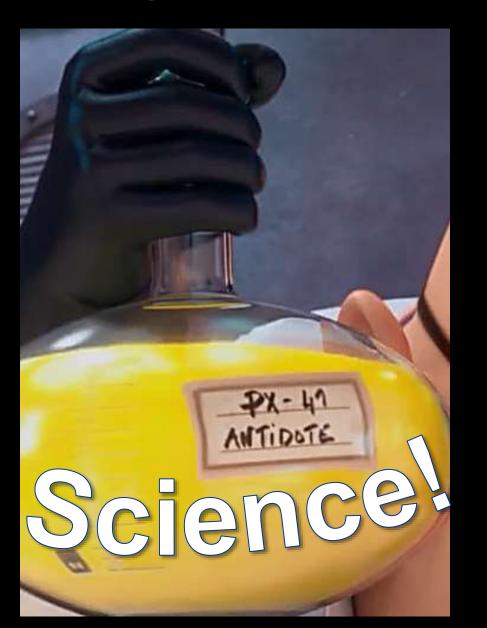




A Philosopher giving a Lecture on the Orrery in which a lamp is put in place of the Sun,

Joseph Wright of Derby, 1766

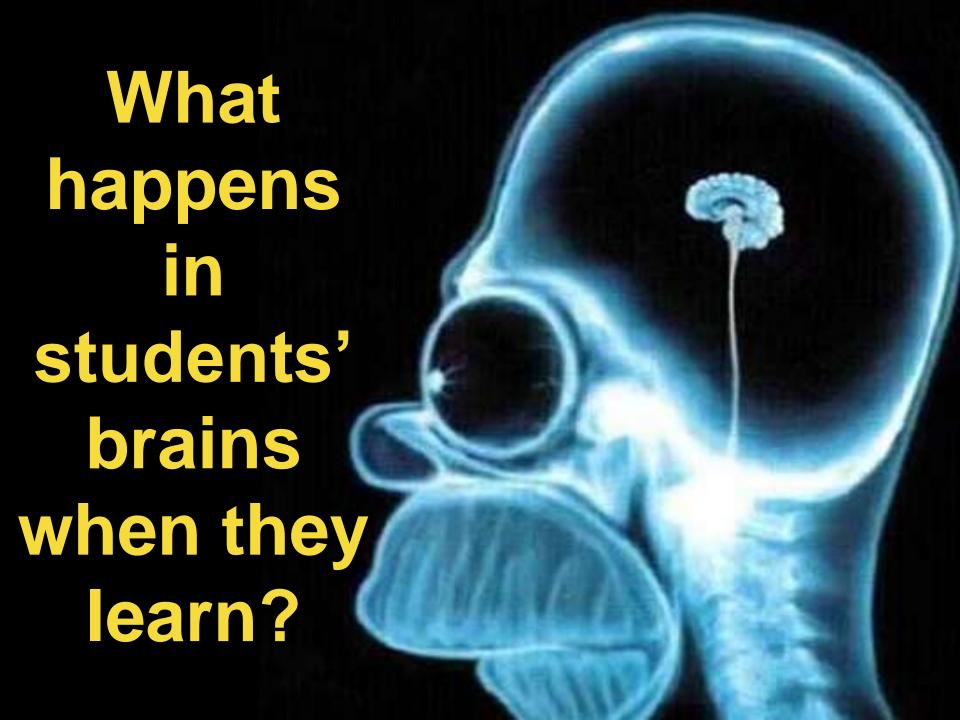
A Scientific Revolution

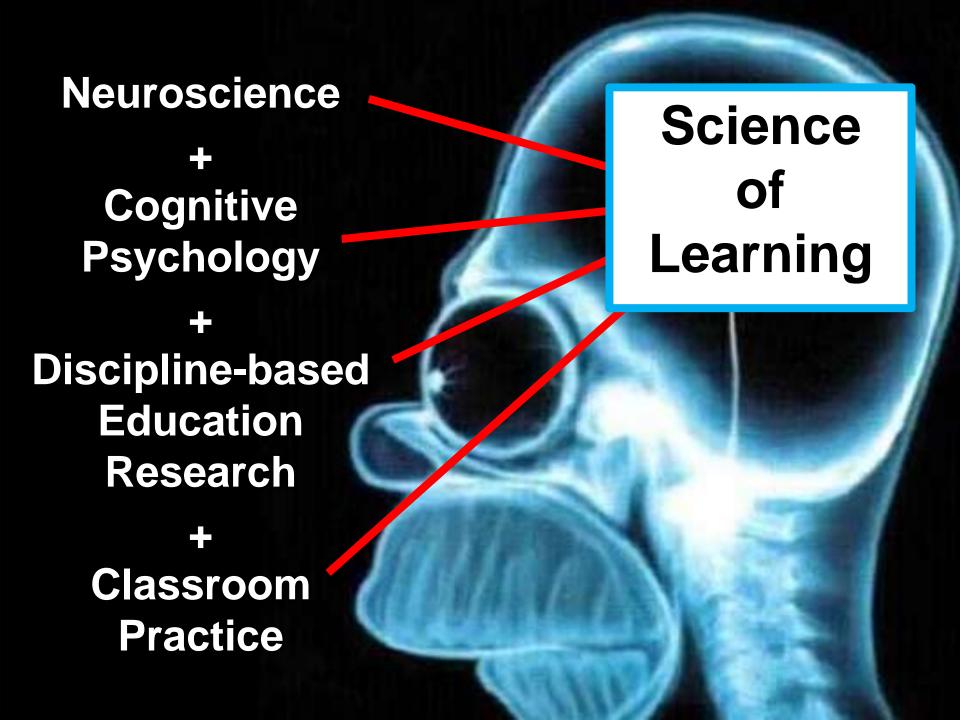


Antidote for:

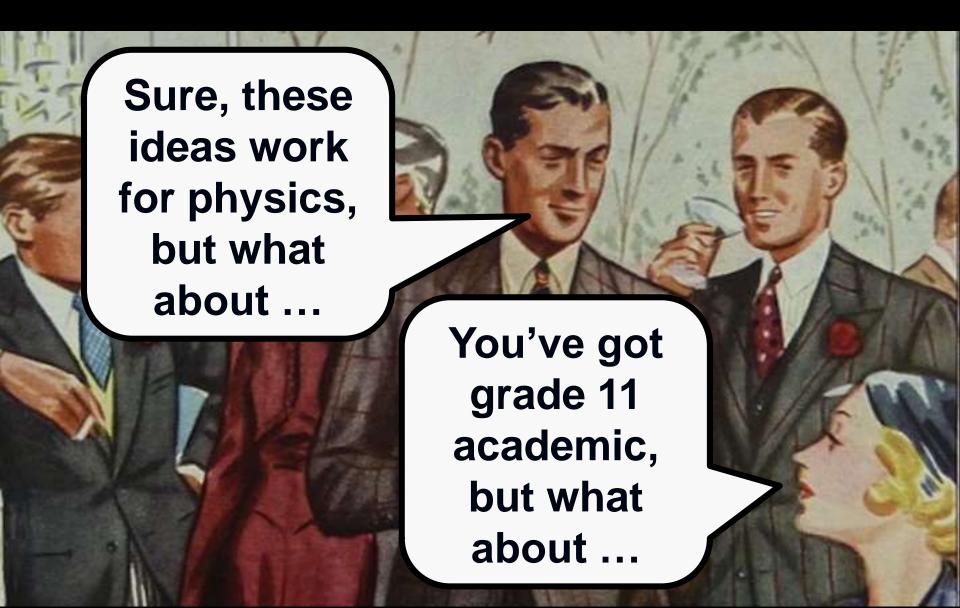
- Pedagogical fads
- Prejudices
- Personal Inertia

Provides New Tools





Please Help Me!



Scenes from Your Teaching



Dramatis Personae: You, Your students

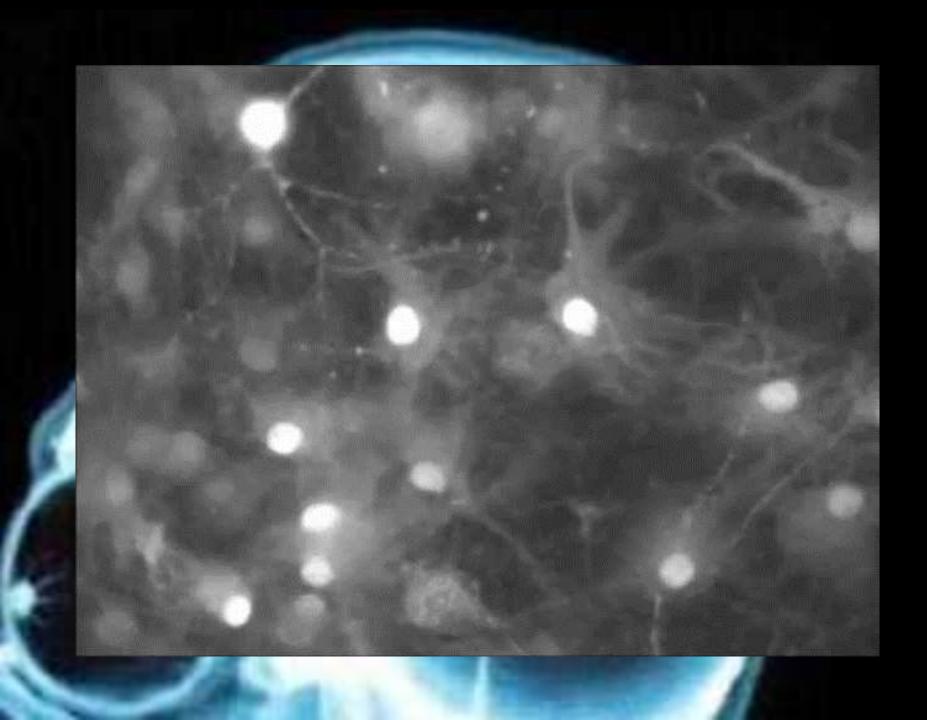
Act 1, Scene 1

A student gives up quickly, exasperated You think: but you haven't even tried!?!

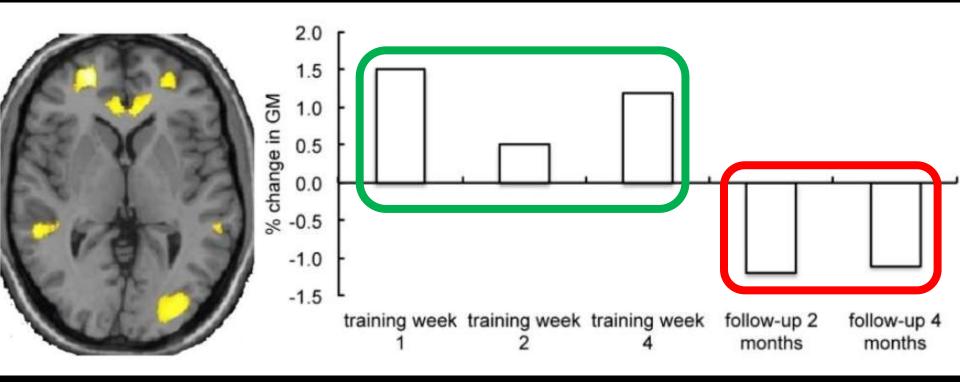
Why does this happen?

Discuss with your neighbours





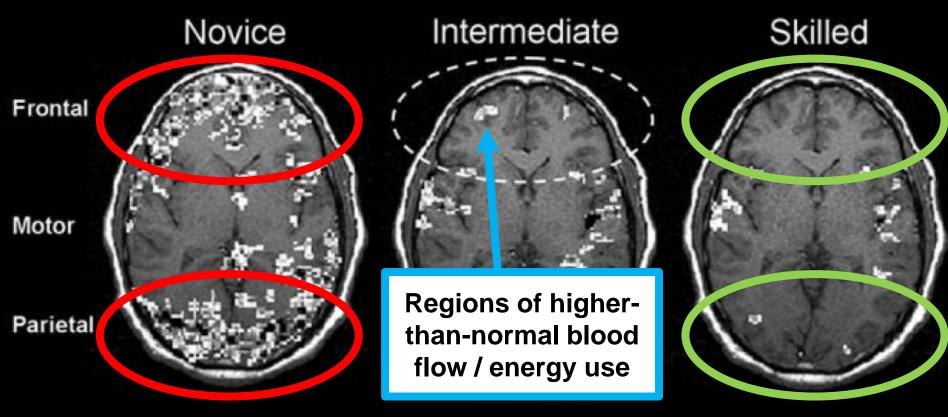
Learning a New Task



Brain tissue grows or shrinks just like muscles do.

Zatorre, R. J., Fields, R. D., & Johansen-Berg, H. (2012). Plasticity in gray and white: neuroimaging changes in brain structure during learning. *Nature neuroscience*, *15*(4), 528-536.

Watch the Brain Learn

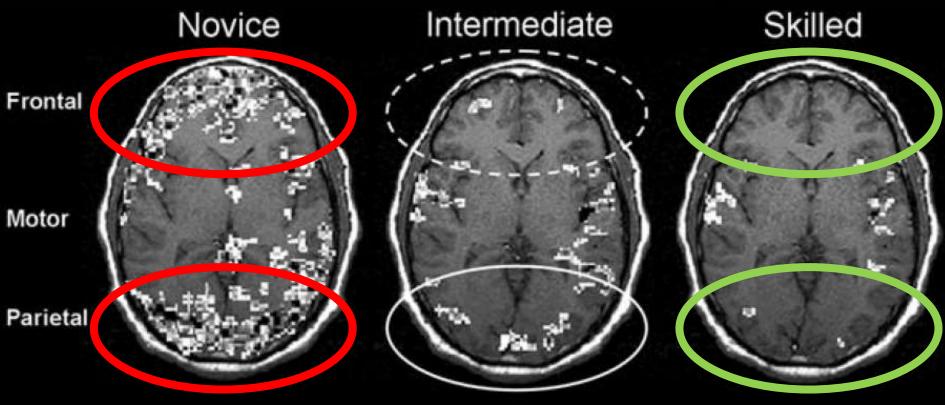


What is happening in the brain? How does this feel to the owner?

Hill, N. M., & Schneider, W. (2006). Brain changes in the development of expertise: Neurological evidence on skill-based adaptations. From: The Cambridge handbook of expertise and expert performance (pp. 653-683).

1:00 Stop

Watch the Brain Learn



Learning something new is energy intensive and tiring

60 minutes later!

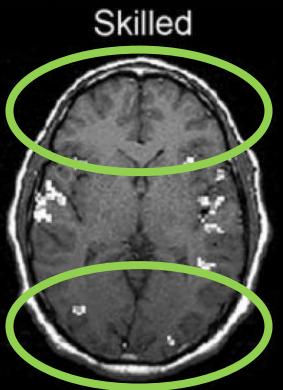
Hill, N. M., & Schneider, W. (2006). Brain changes in the development of expertise: Neurological evidence on skill-based adaptations. In Cambridge handbook of expertise and expert performance (pp. 653-683).

The Expert

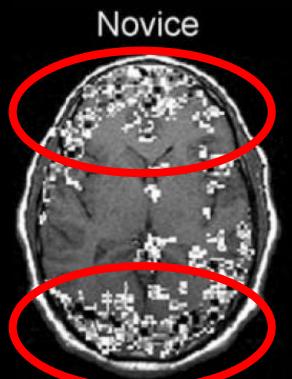


Fluent

Skills invisible and automatic



The Novice



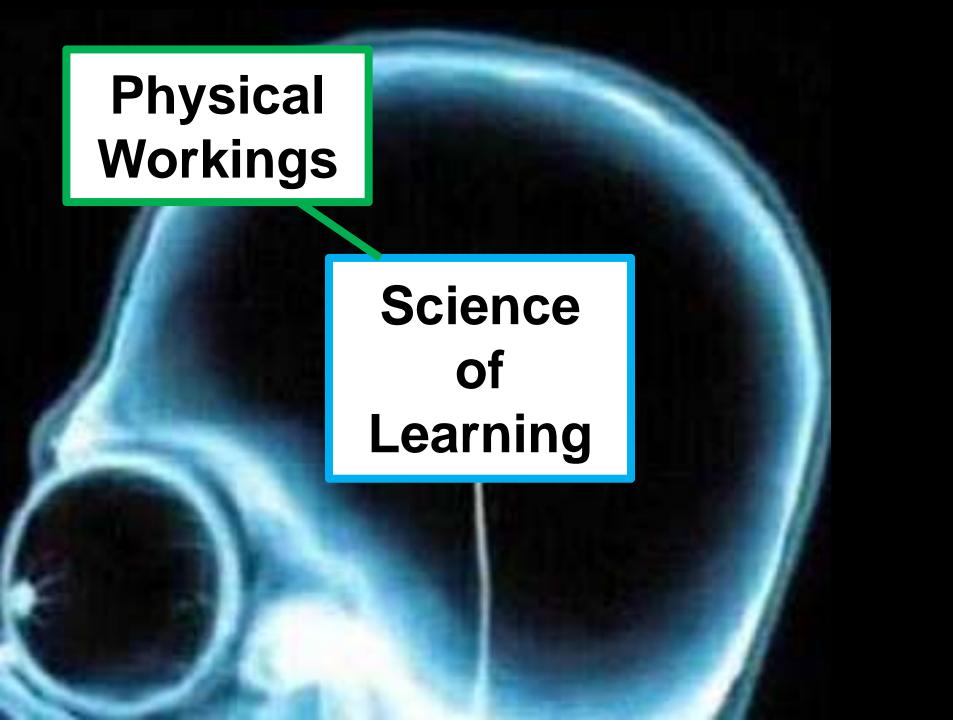
Lack Fluency

Skills are effortful and slow



Random Toddler from the Internet





Classroom Practice

Learning is tiring but with persistence it becomes easy. You have successfully learned many, many things.

How can you help students with this in your classroom practice?

Discuss with your table and record on chart paper

Act 1, Scene 2

You instruct the class:
"Ok everybody, I want you to ...".
A student simply refuses.
Why does this happen?
Discuss with your neighbours

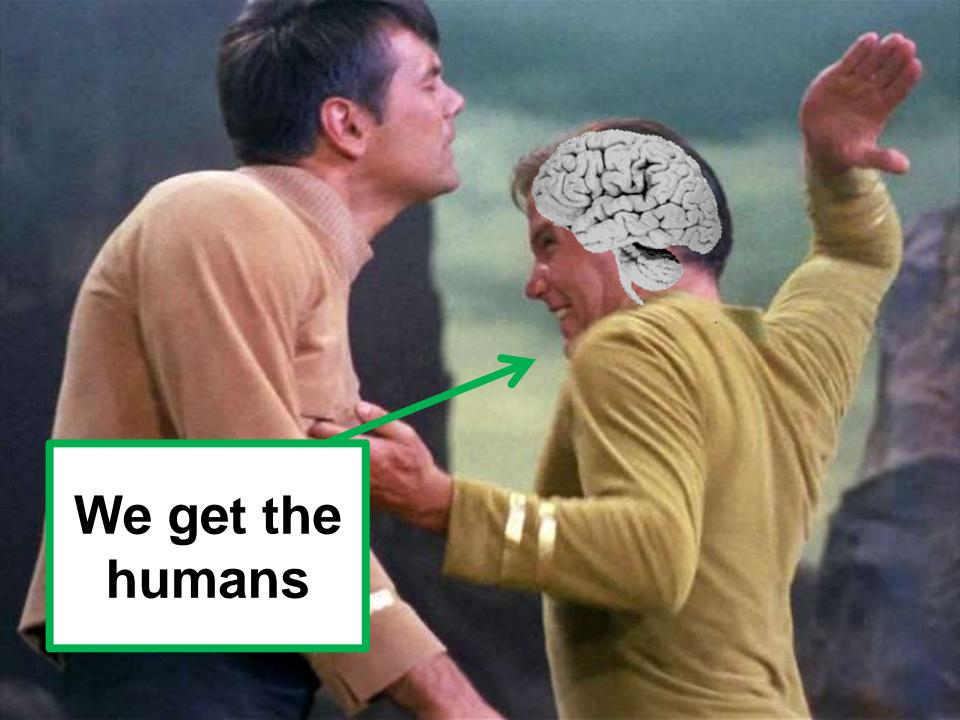


Physical Emotion Workings **Science** of Learning



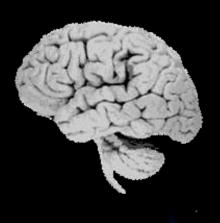
Cognition
Can't Be
Separated
from
Emotion





Survivor

What are the brain's main tools for survival?



Must ... make it ... to syndication

Understand its environment



Control its body





Find pleasurable things



Understand its environment

Control body's actions

Emotional Response

Avoid danger

Find pleasurable things

Zull, J. The Art of Changing the Brain. 2002

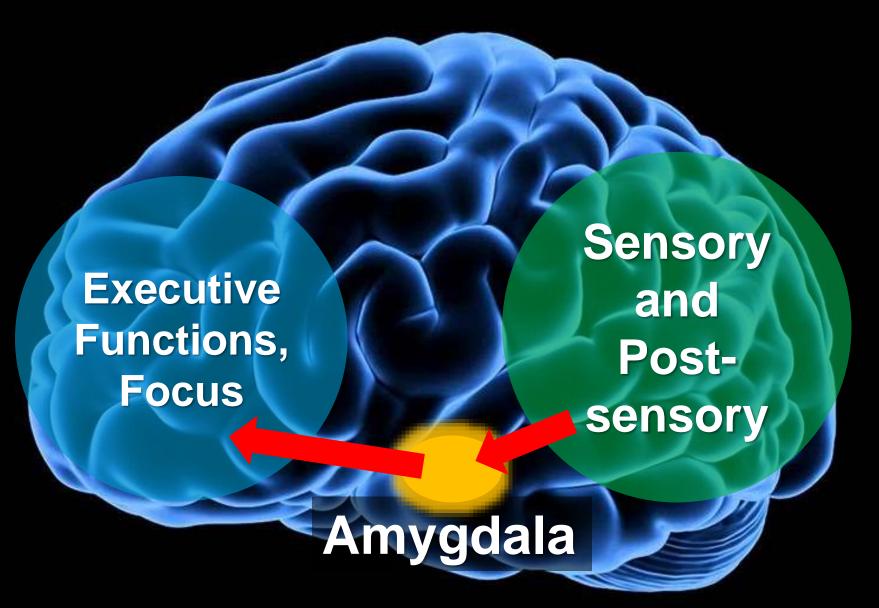
Classroom Examples

From your classroom, what are positive and negative examples of:

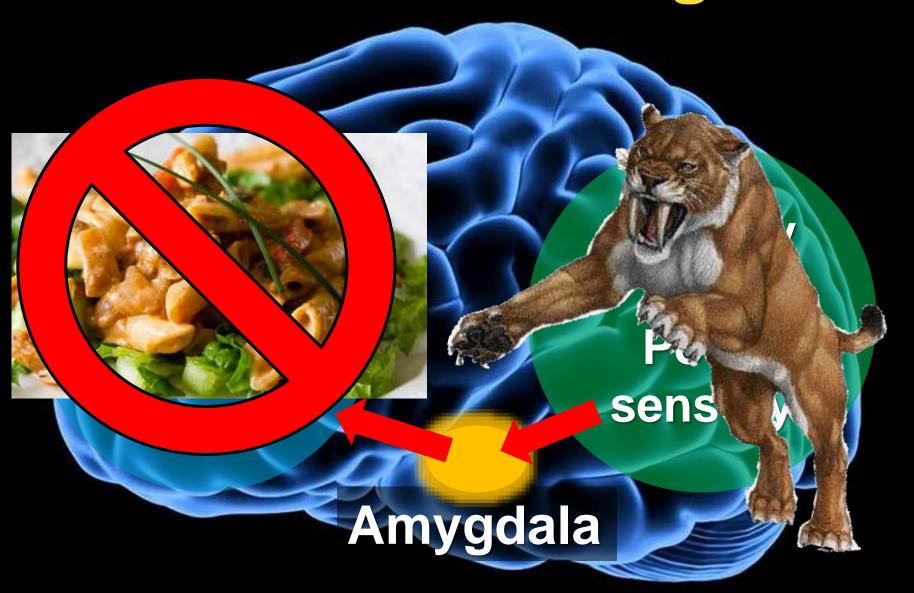
- avoiding danger
- finding pleasurable things
 - controlling one's body



The Brain Protects Itself



Focuses on the Negatives



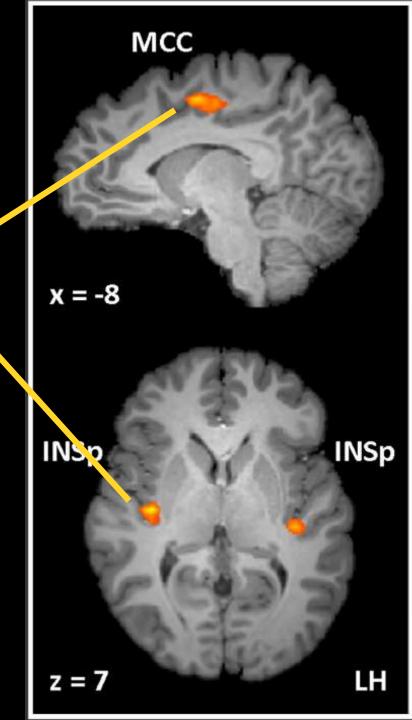
Anxiety!



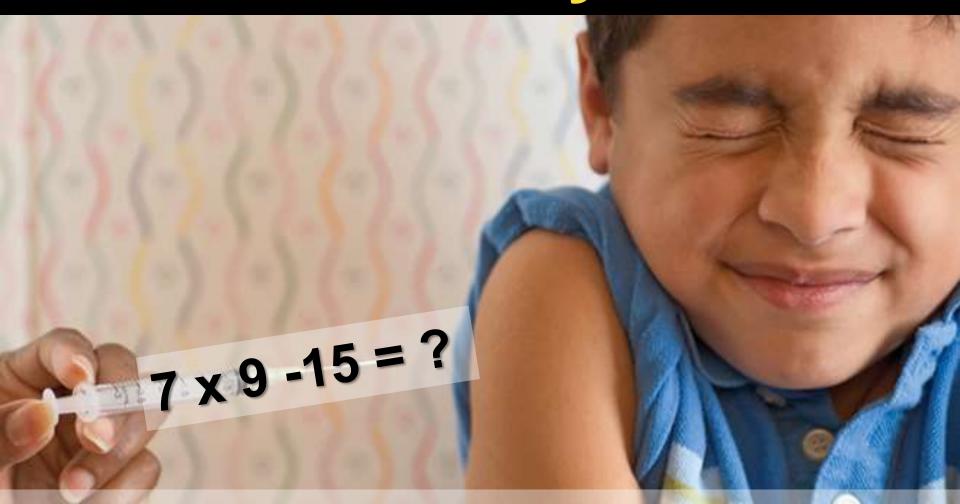
Anxiety!

Activation of brain regions associated with perception of physical pain.

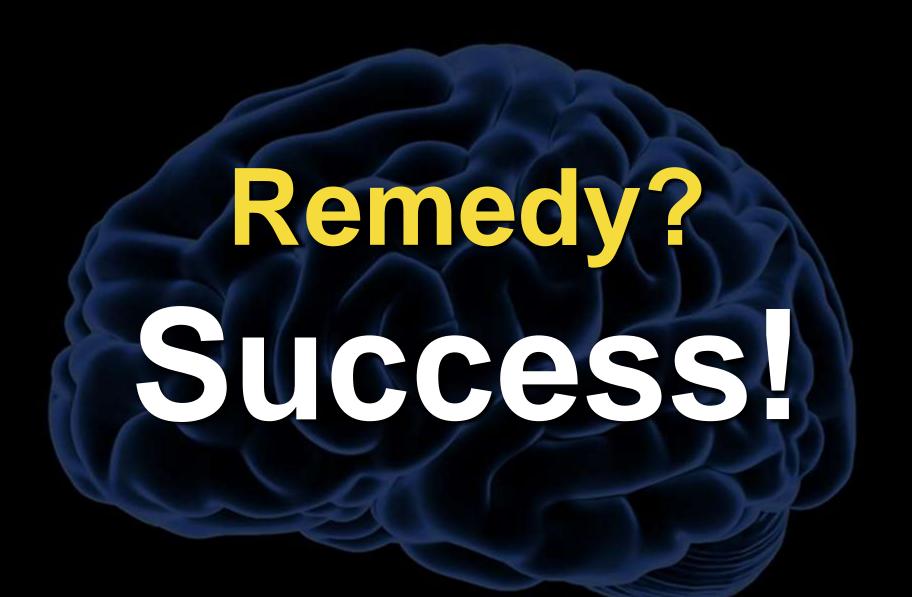
Lyons, I. M., & Beilock, S. L. (2012). When math hurts: math anxiety predicts pain network activation in anticipation of doing math. PloS one, 7(10), e48076



Anxiety!



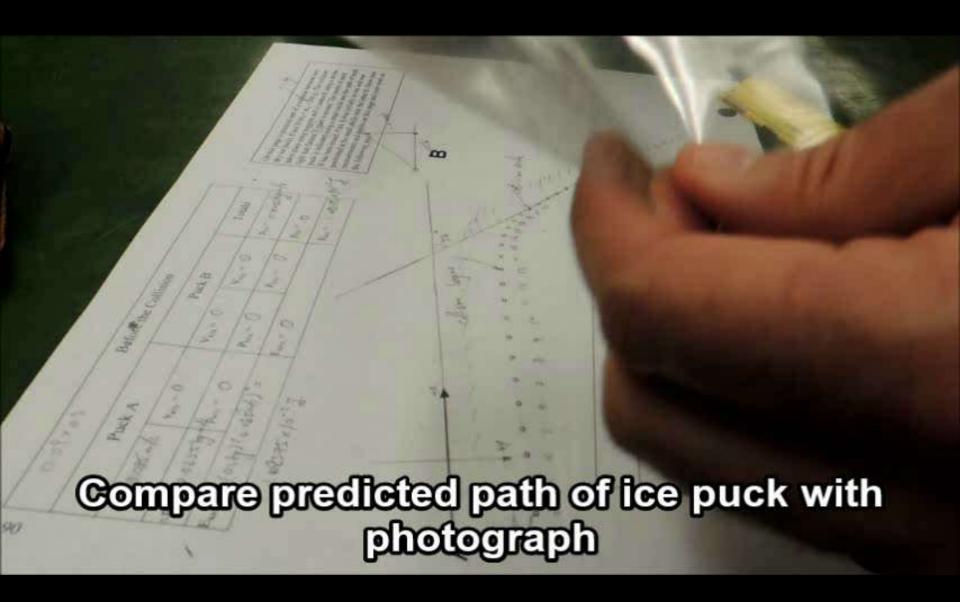
Be mindful of the negative emotions our students experience when learning.



Success?



Success!

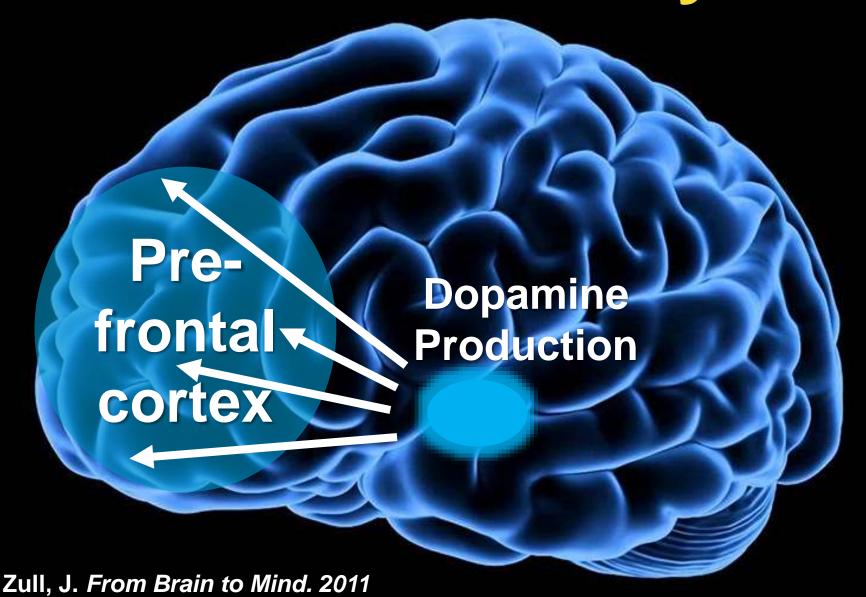


Success!

Why is this type of success different?

0:30 Stop

Internal Reward System



Classroom Practice

Humans like to do the things they are successful doing.

How to help students perceive that they are successful?

Discuss with your group and record on chart paper

Act 1, Scene 3

In class, the kid has got it!
The next day, back to zero!
Why does this happen?
Discuss with your table



Skill-Testing Question

Compare the size:

4 2 8

Skill-Testing Question

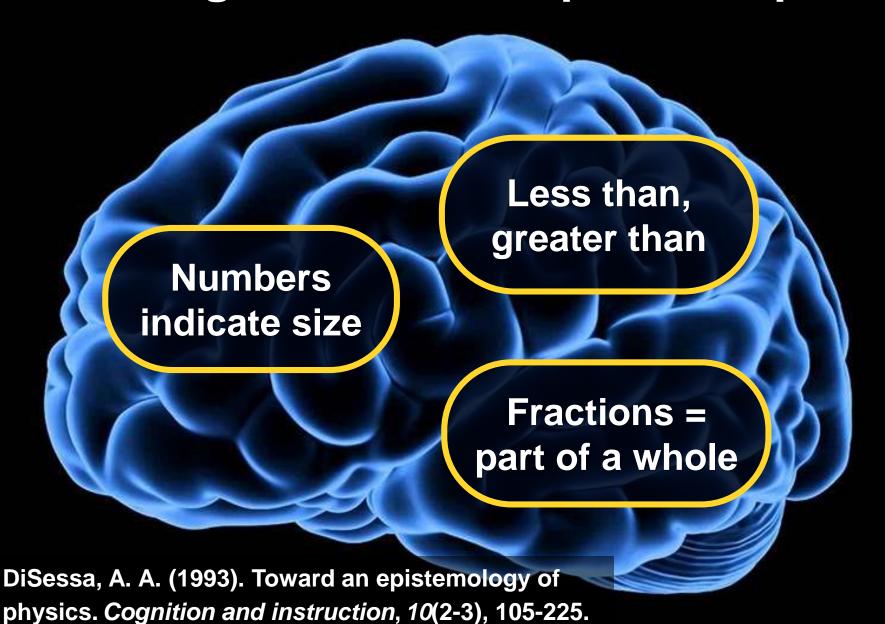
Compare the size:

Why does this happen?

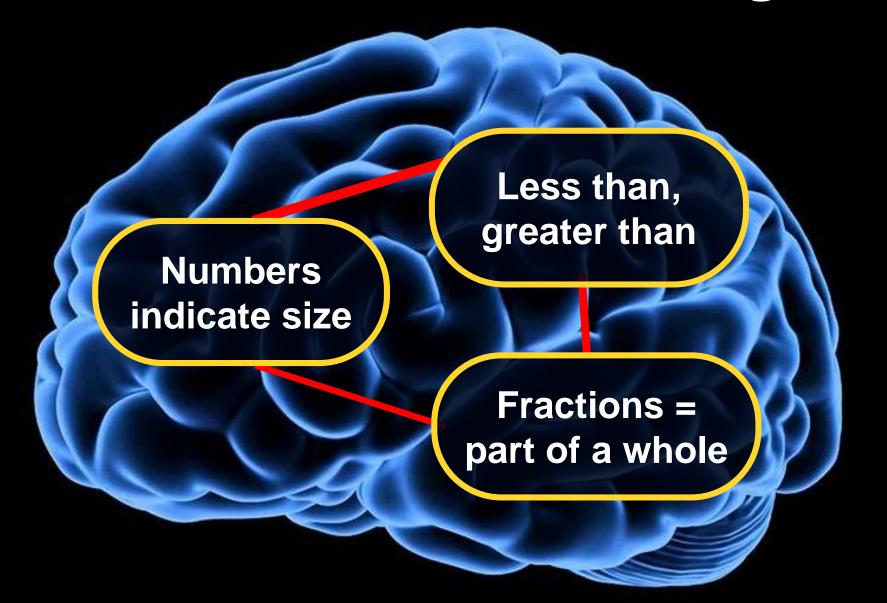
Empty Vessel Model



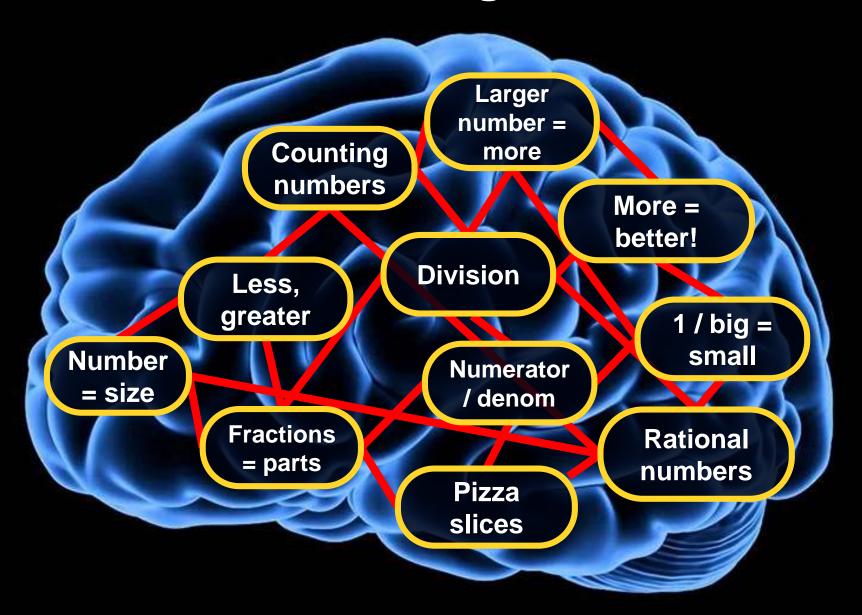
Knowledge is built from primitive pieces



As we learn, connections grow



Networks of knowledge resources form

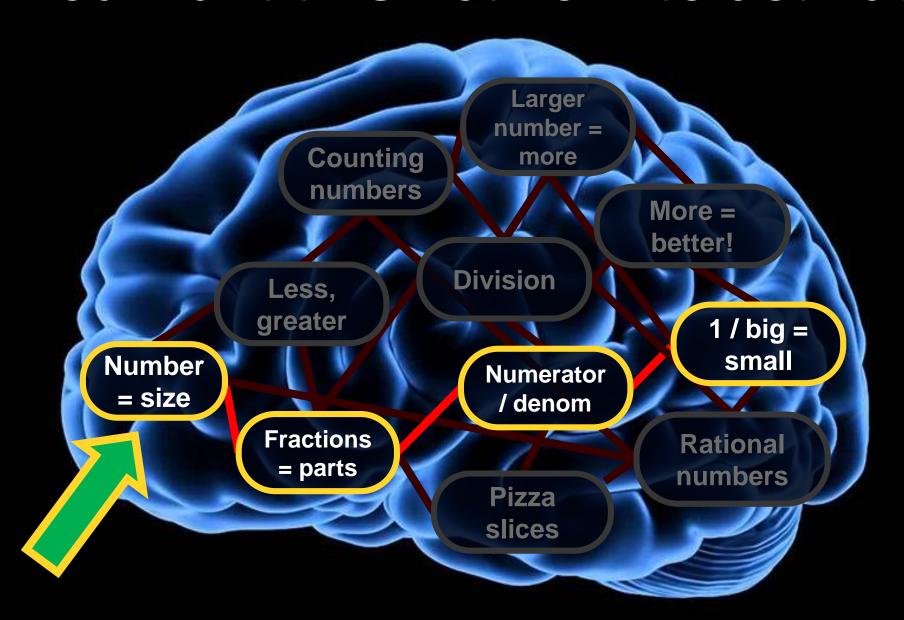


Prior Knowledge

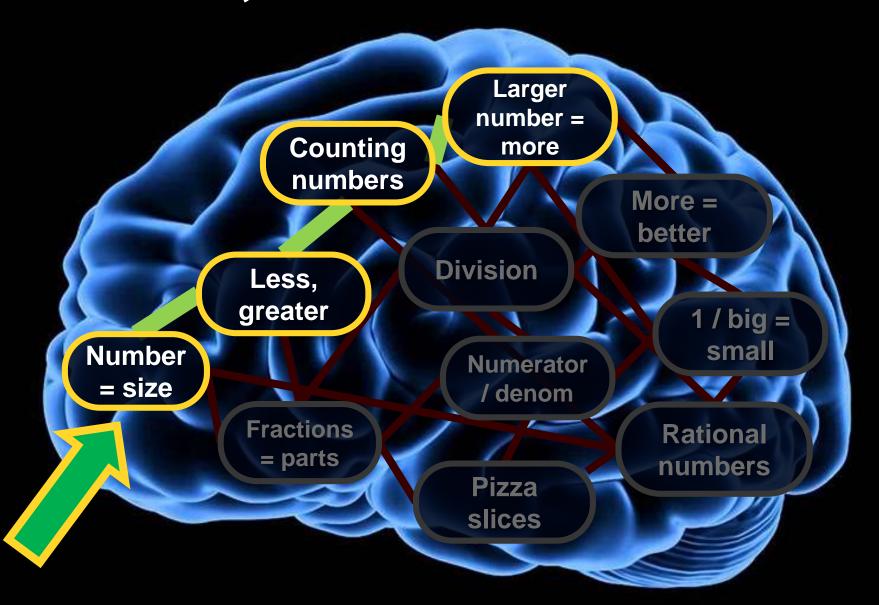
is the collection of knowledge resources that students bring into our classroom.

When we recall knowledge, we activate networks of resources

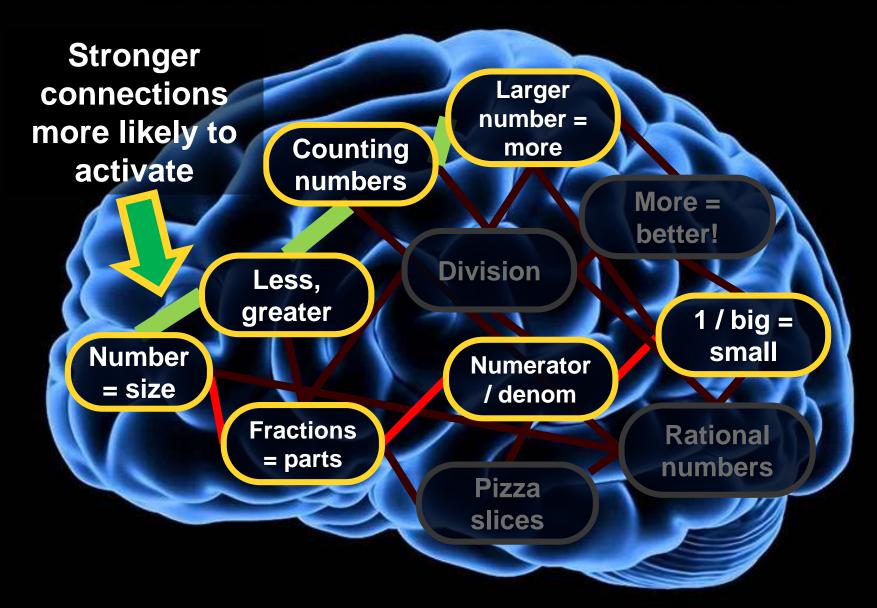
You want this network to activate



Instead, this one is activated!



Both are in there!



Prior Knowledge

Strongly connected prior knowledge can conflict with new knowledge for a surprisingly long period of time.

The Expert

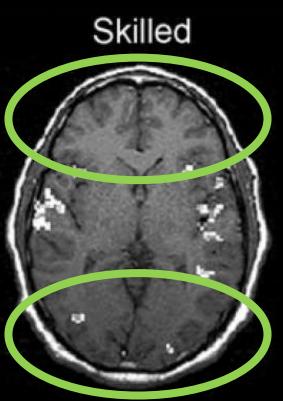


Fluent

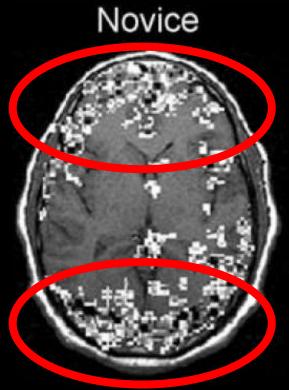
Skills invisible and automatic

Consistent

Strong, stable connections



The Novice



Lack Fluency

Skills are effortful and slow

Inconsistent

Weak, unstable connections



Brain Emotion Workings **Science** of Learning **Prior** Knowledge

Time for a test!

Learn This!

$$L = 3$$

$$\Box = 4$$

$$\square = 5$$

$$\Box$$
 = 6

$$\neg = 7$$

$$\square = 8$$

$$\Gamma = 9$$

$$\bigcirc$$
 = 0

0:30

Test Time!

$$L \Pi = 38$$

$$\Box = 27$$

$$\Box \circ = 40$$

Discuss!

Discuss any patterns you find amongst the numbers and shapes.







Test Time!

$$\Box$$
 \Box = 48

$$\Box = 15$$

Prior Knowledge

Activating helpful prior knowledge can assist the learning of new ideas.

Classroom Practice

Prior knowledge can help or hinder learning.

What are examples of this from your classes?

Discuss with your group and record on chart paper

Act 1, Scene 4

Students do well on basic, standard tasks. Give them something a little bit different and they fall apart.

Why does this happen? Discuss with your table





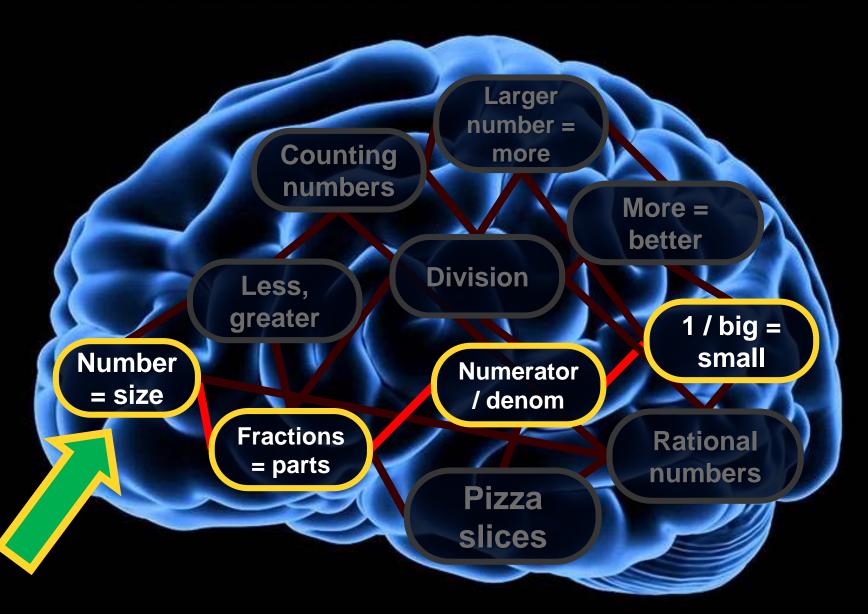
You know it or you don't

It's not rocket science geez

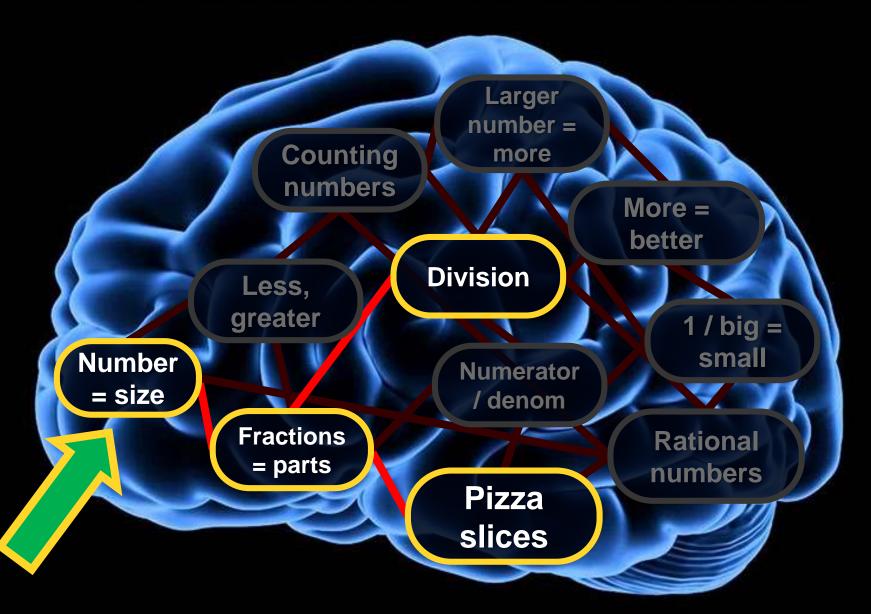


Knowledge resources are activated differently based on context.

"Fractions" is activated



"Fractions" is activated



The Expert



Fluent

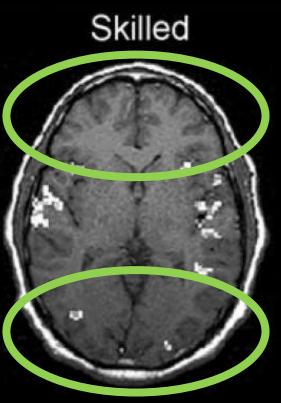
Skills invisible and automatic

Consistent

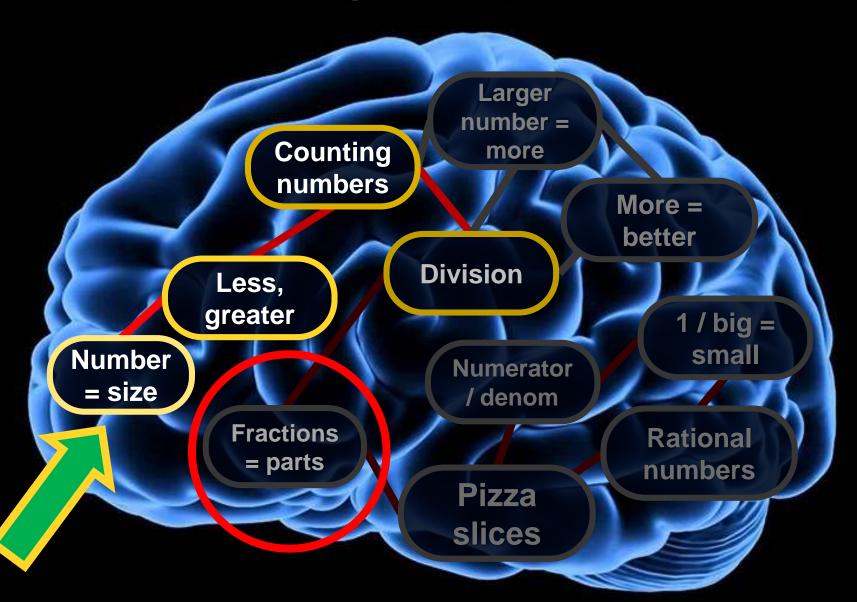
Strong, stable connections

Contextual

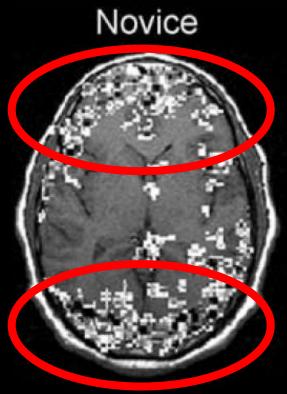
Richly connected networks



Or not!



The Novice



Lack Fluency

Skills are effortful and slow

Inconsistent

Weak, unstable connections

Non-contextual

Sparsely connected

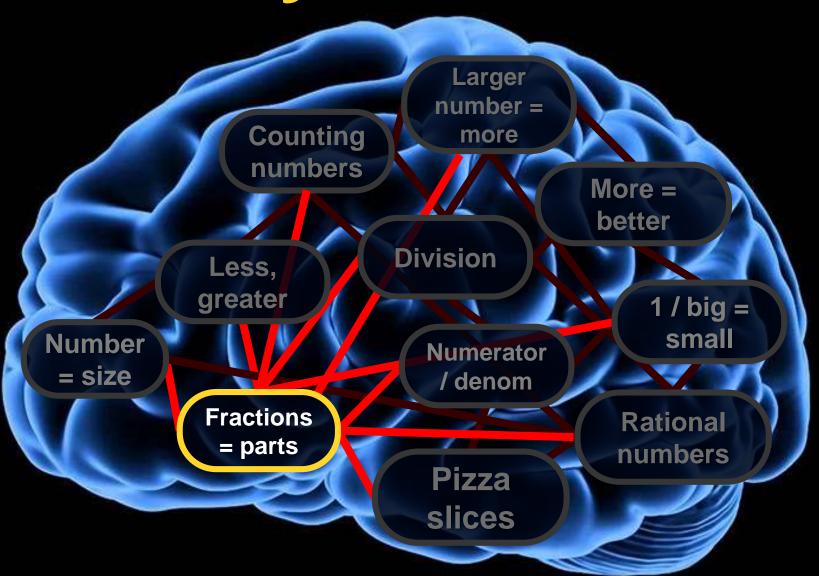


Transfer

The ability to use productively knowledge learned in one context in another.

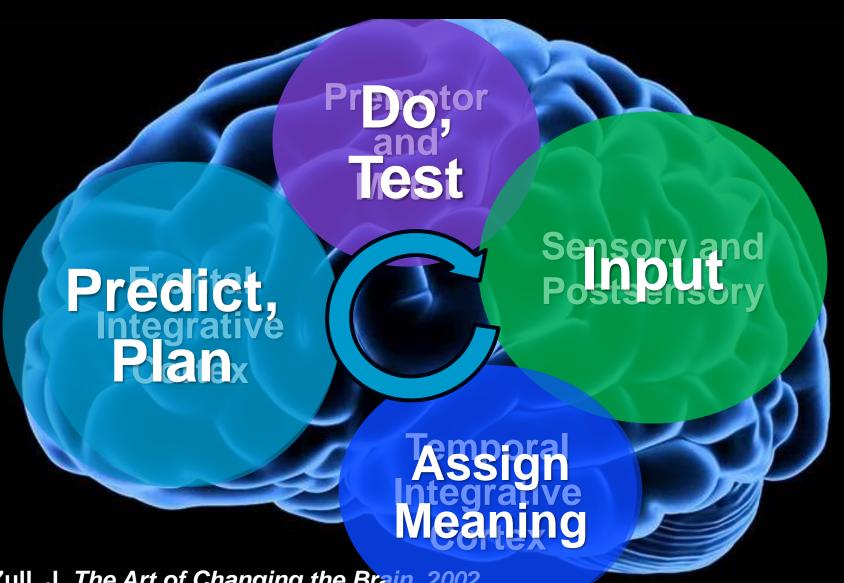
Gold Standard of Learning

Ability to Transfer



How to make connections?

Cognitive Learning Cycle



Zull, J. The Art of Changing the Brain. 2002

Brain's Learning Engine

The brain is hardwired to make sense



Brain Workings

Emotion

Science of Learning

Prior Knowledge

Cognitive Learning Cycle

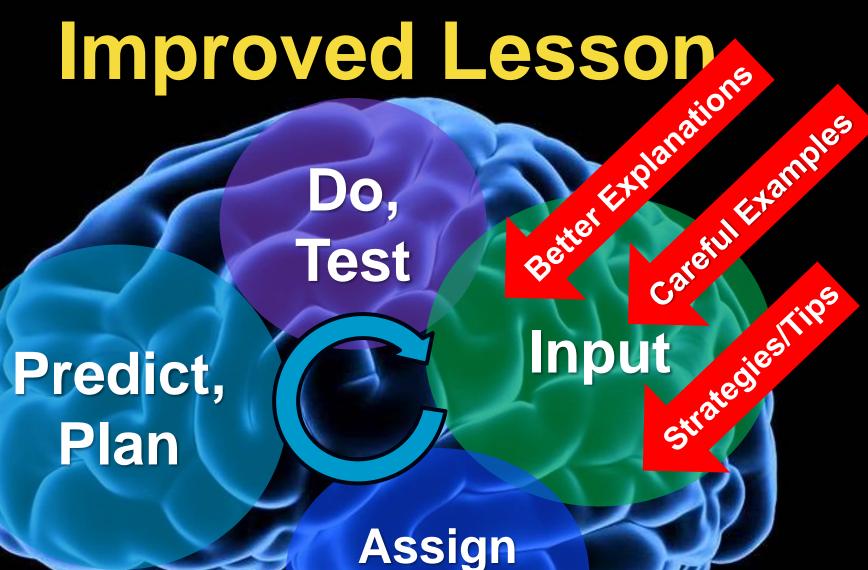
Act 2, Scene 1

The Science of Learning



Now I know where they have trouble!

Time for an improved lesson

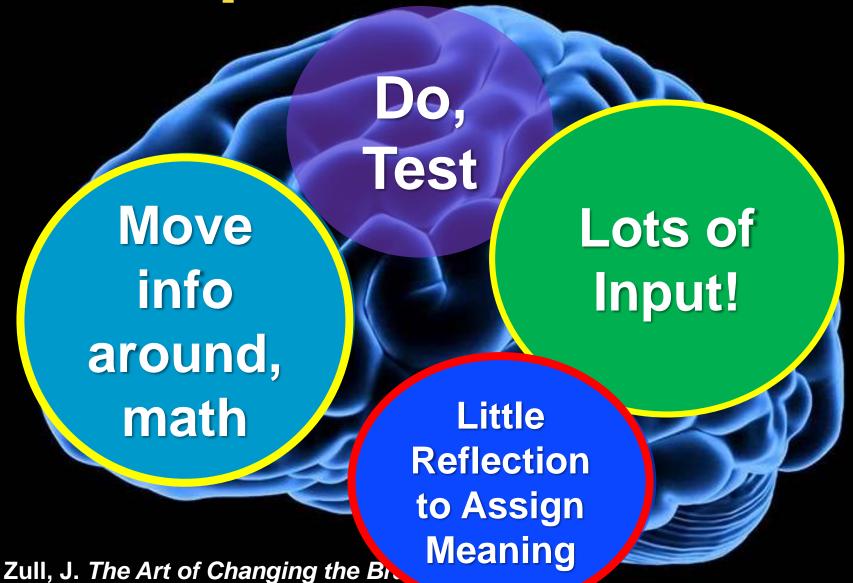


Assign Meaning

Zull, J. The Art of Changing the Brain. 2002



"Improved" Lesson



Grammar vs. Meaning

"Twas brillig, and the slithy toves Did gyre and gimble in the wabe; All mimsy were the borogoves, And the mome raths outgrabe."

Lewis Carrol, Through the Looking-Glass, and What Alice Found There (1871)

Lots of shortcuts to save energy

roved" Lesson

Meaningful Tests

Move info around, math

Lots of Input!

Little
Reflection
to Assign
Meaning

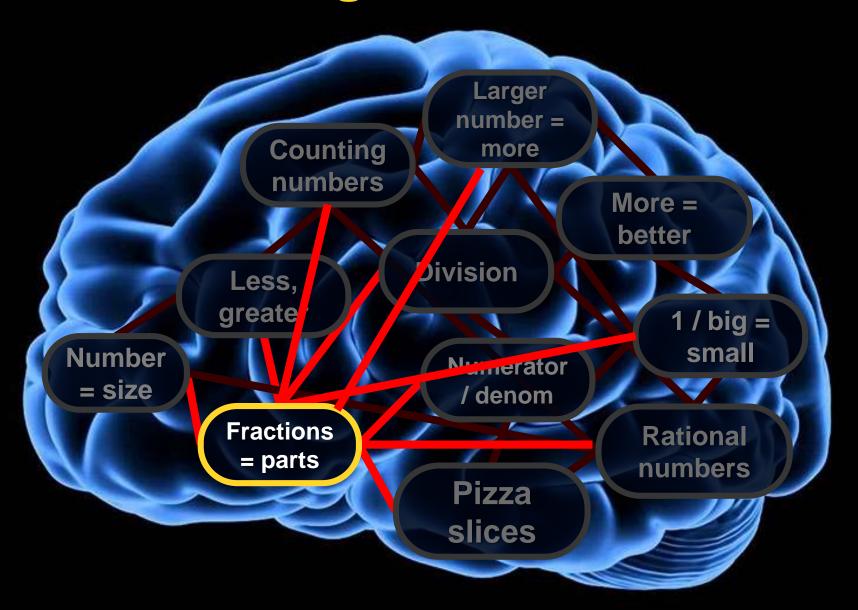
Zull, J. The Art of Changing the Br

Learning Cycle = Sense-making

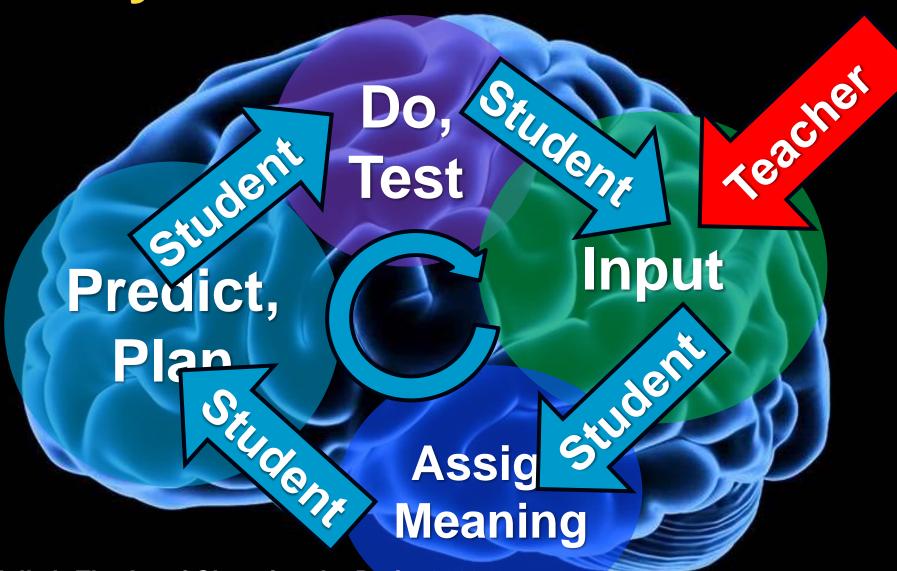
We make sense of new ideas by connections them to our prior knowledge.

Without opportunities for sensemaking, students cannot transfer knowledge.

Sense-making = Rich Connections



Only students can connect!



Zull, J. The Art of Changing the Brain. 2002

Classroom Practice

Teachers can't tell students what to know. Students must explore, construct, test, and refine their understanding.



Very Frustrating!

You have so much to share! So much passion! Must be adjusted to students' needs



Pedagogy

The closest match:

Inquiry!

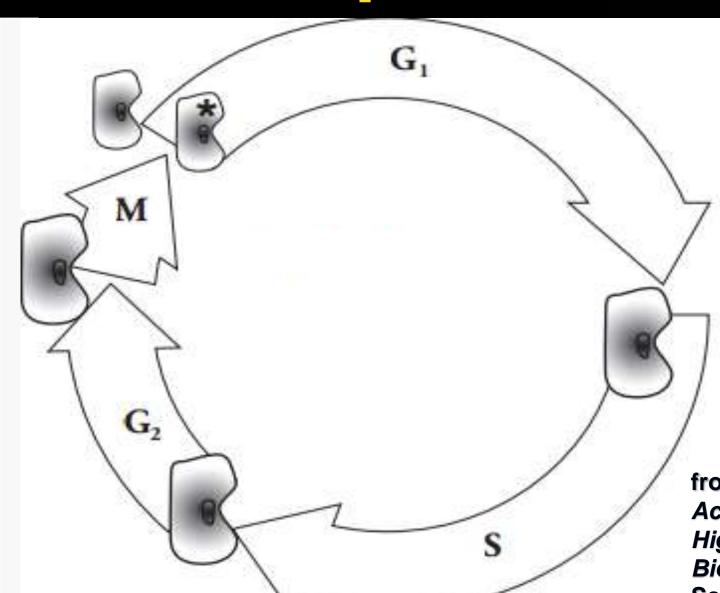
Example

The Life Cycle of a Cell

Input

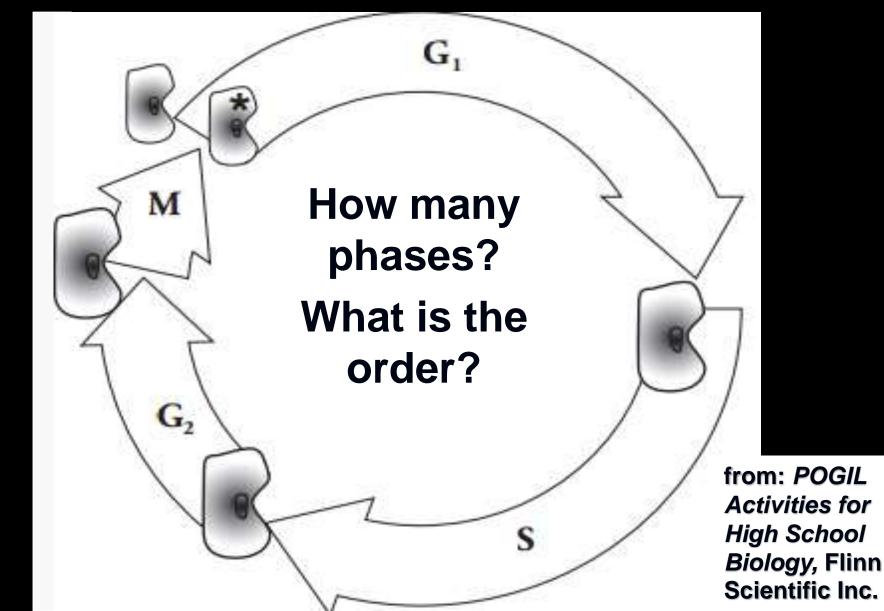
0:30

Stop

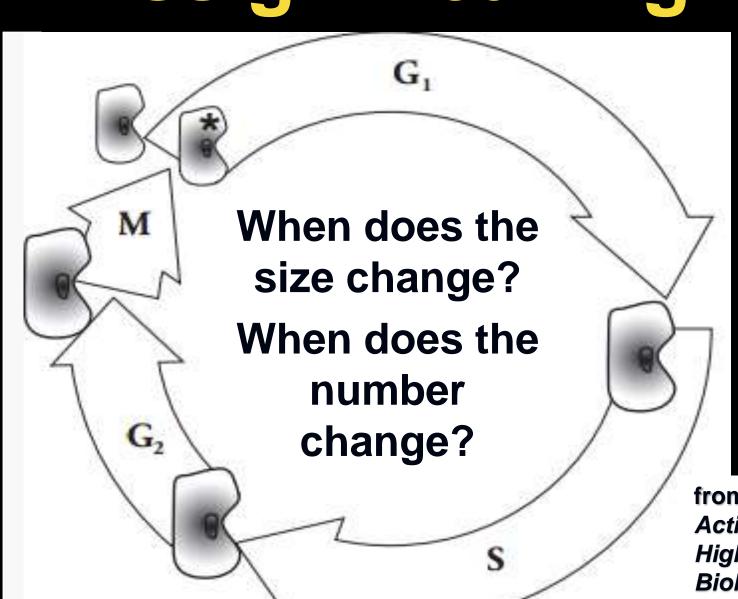


from: *POGIL*Activities for
High School
Biology, Flinn
Scientific Inc.

Assign Meaning

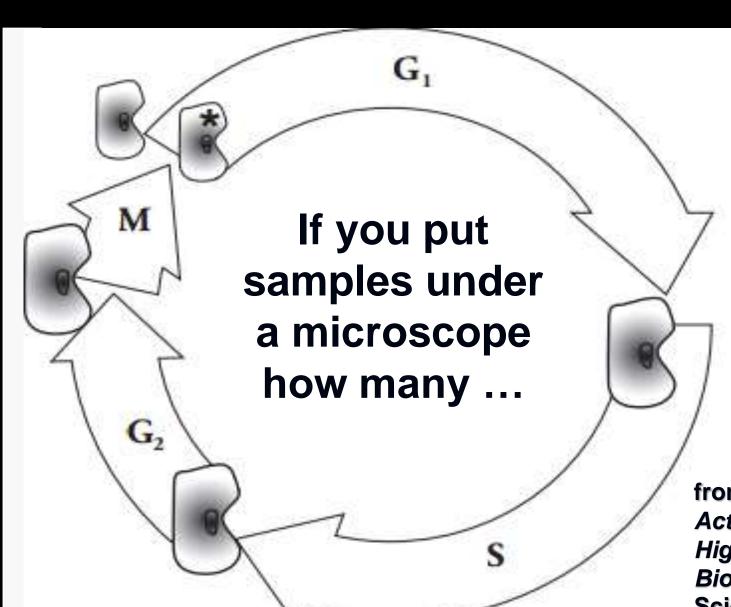


Assign Meaning



from: POGIL
Activities for
High School
Biology, Flinn
Scientific Inc.

Predict



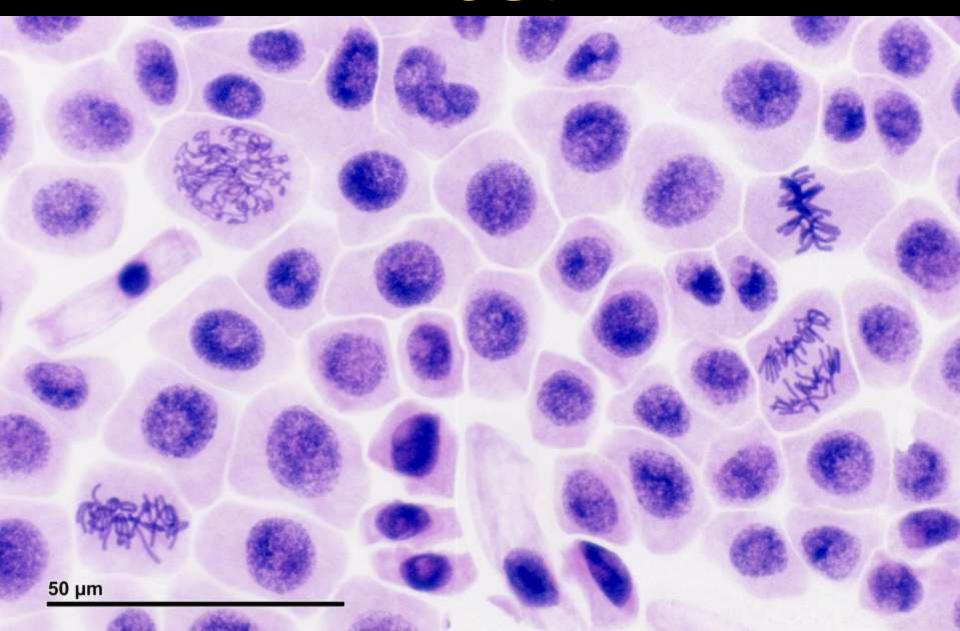
from: *POGIL*Activities for

High School

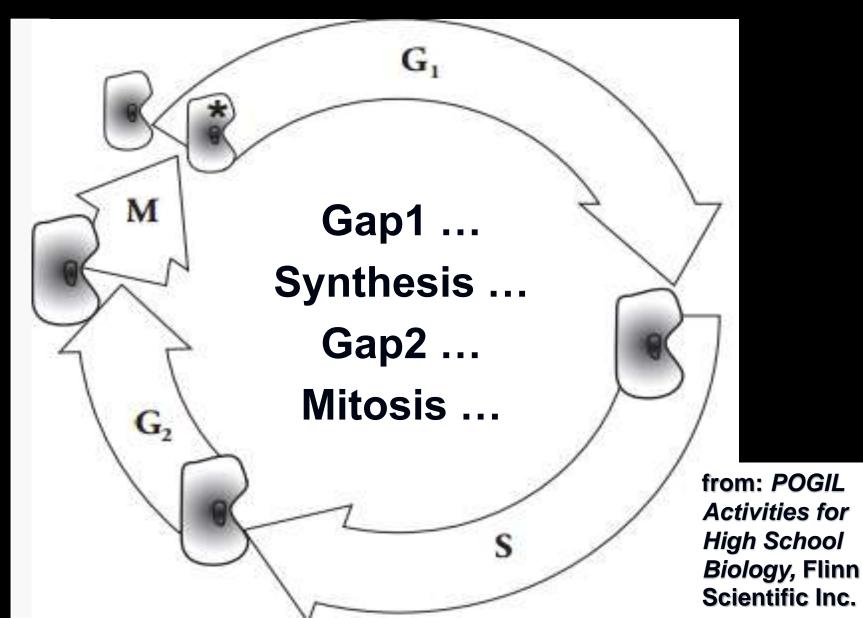
Biology, Flinn

Scientific Inc.

Test



Input



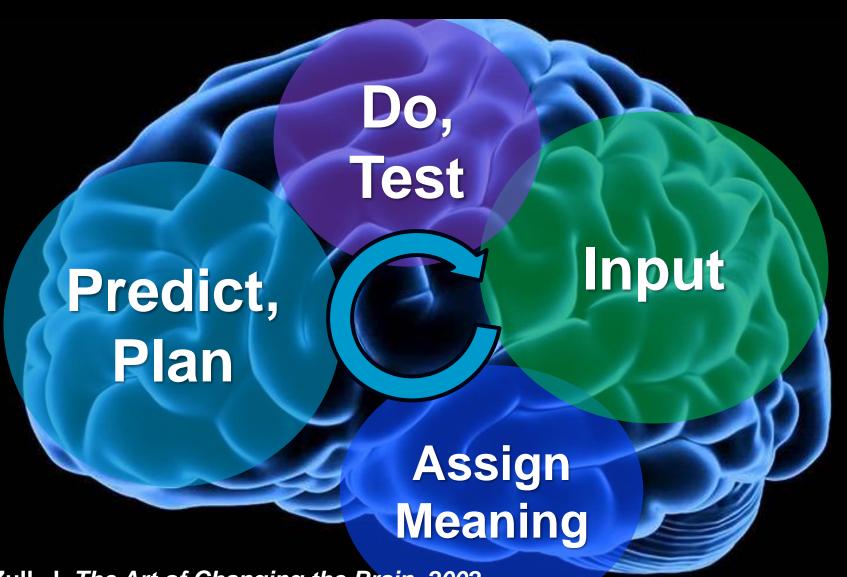
Sample Lessons

Choose History or Physics!

- Identify the part(s) of the cognitive learning cycle activated by each question or step
 - How does each question help the novice?

Discuss in small groups of 3 or 4 Record ideas on your page

Cognitive Learning Cycle



Zull, J. The Art of Changing the Brain. 2002

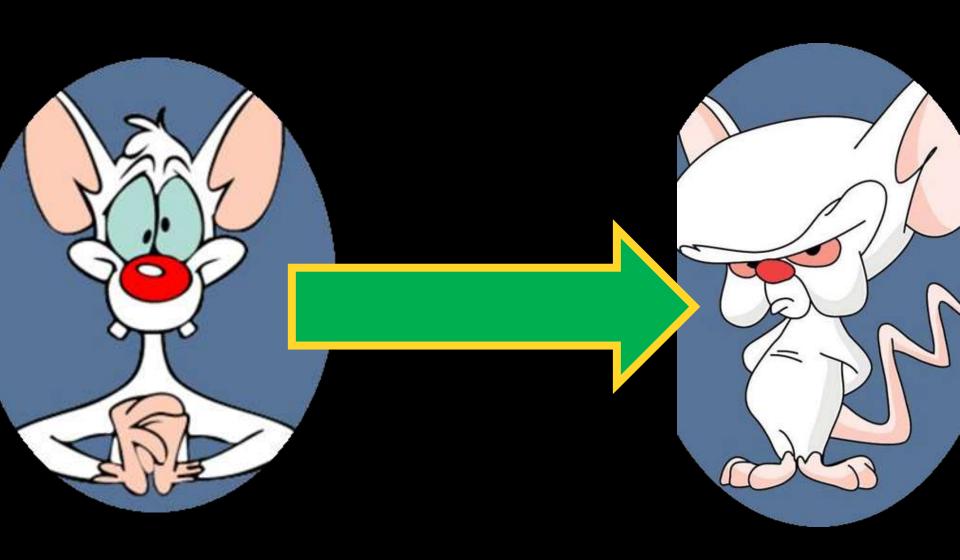
The Measure of Teaching?

How well is the How well are material presented? students learning!



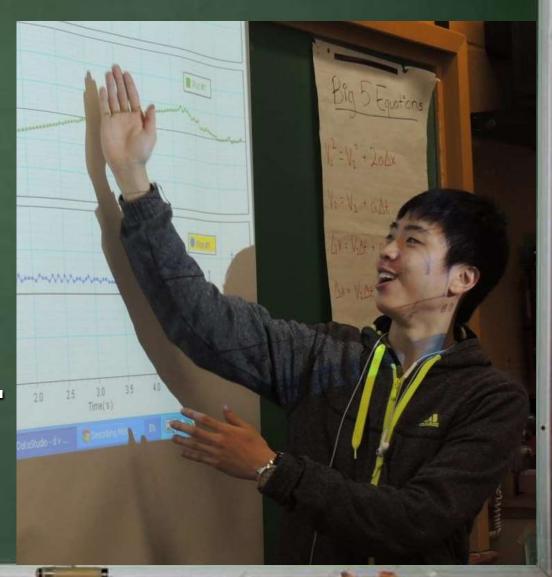


Our Teaching Goal



Our Teaching Goal

What matters most in the classroom is what goes on in each student's head.



Teach students how their brains work

Design lessons with emotion in mind

Science of Learning

Help students connect prior knowledge

Activate the cognitive learning cycle

Today's Workshop



Zull, J. The Art of Changing the Brain. 2002

Compare how much you talk about the ideas with how much your students do.

Workshop ...

But I'm doing this already.

Your students need to talk more than you.

Help Teachers Learn!

How People Learn



Brain,



Mind,



Experience,



and

School

'A TEACHING APPROACH THAT CAN DRAMATICALLY IMPROVE HUMAN LIARNING," - DAVID A, KOLE "HIGHLY RICOMMINDED." - CHOICE

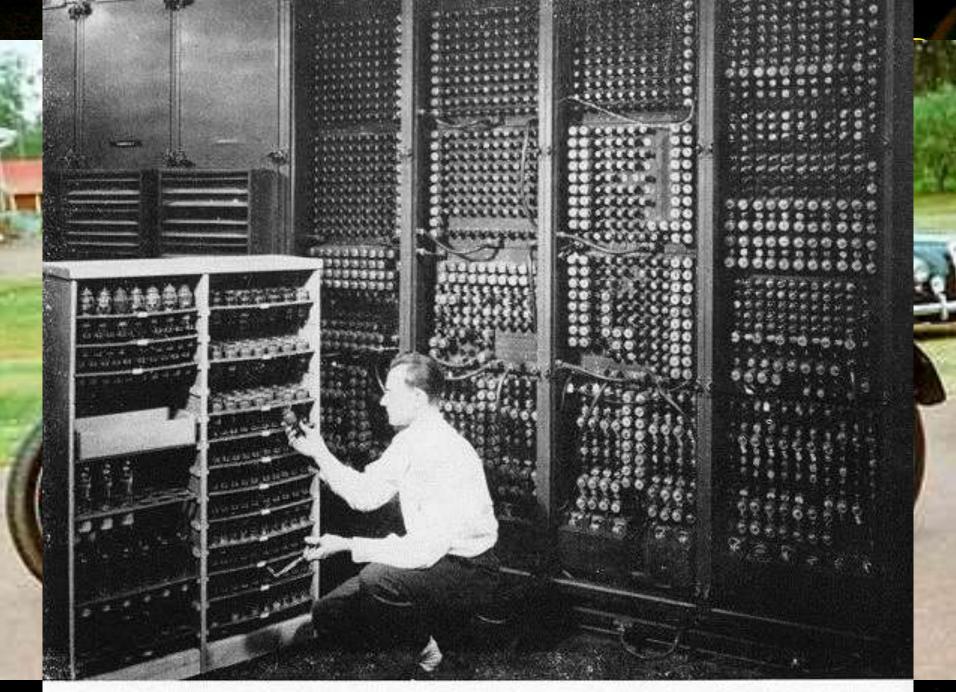


THE ART OF CHANGING THEBRAIN

INRICHING THE PRACTICE OF TEACHING BY EXPLORING THE BIOLOGY OF LIABNING

JAMES E. ZULL

Help Teachers Learn! What can we do to help you learn more? Admin, Risa, myself? Find this presentation: Teacher share > **How People Learn Workshop**



Replacing a bad tube meant checking among ENIAC's 19,000 possibilities.

Embrace Science!

(Hug a Physicist!)

Help Your Students Learn!