



# Gender & Diversity

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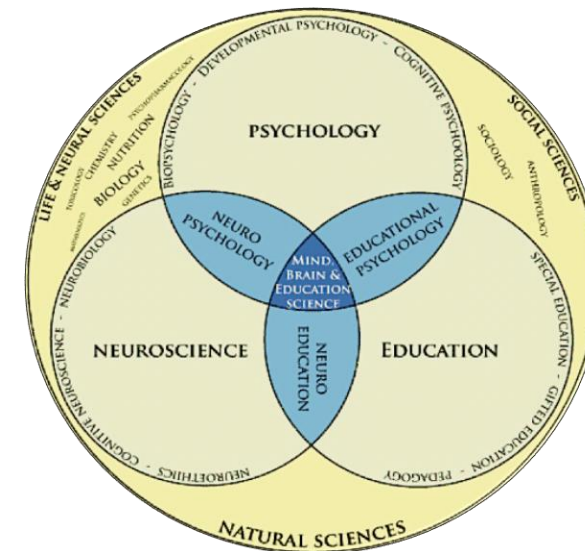
Department of STEM Education & COOL Lab



# Neurodidactics & Co

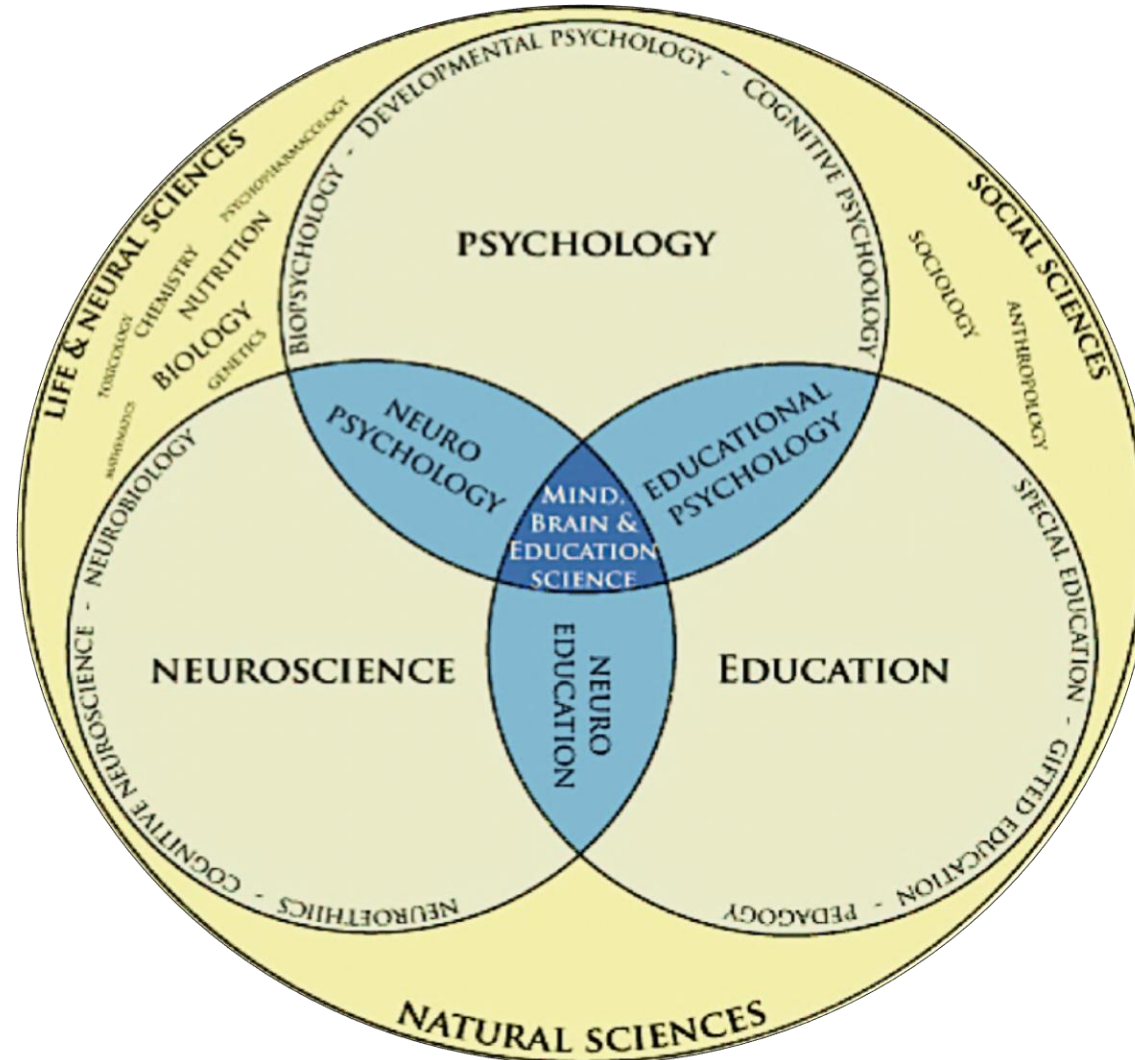
## Interdisciplinary Research Field

- Neurodidactics
- Neuropedagogy
- Brain-based Learning
- Educational Neuroscience
- Mind, Brain and Education Science





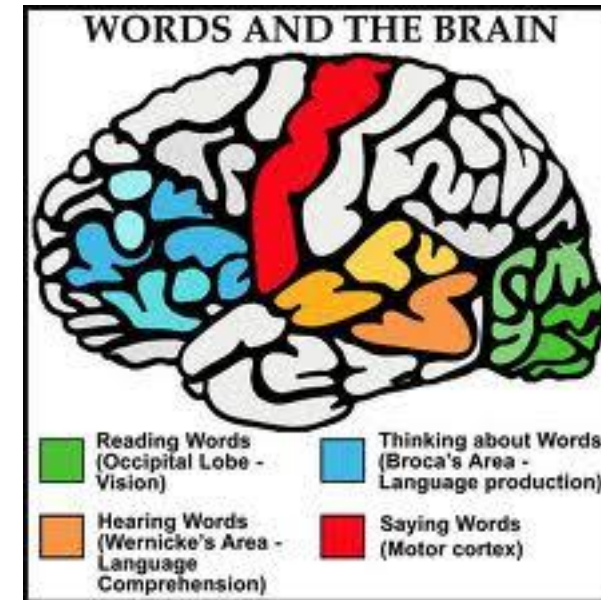
# Mind, Brain & Education



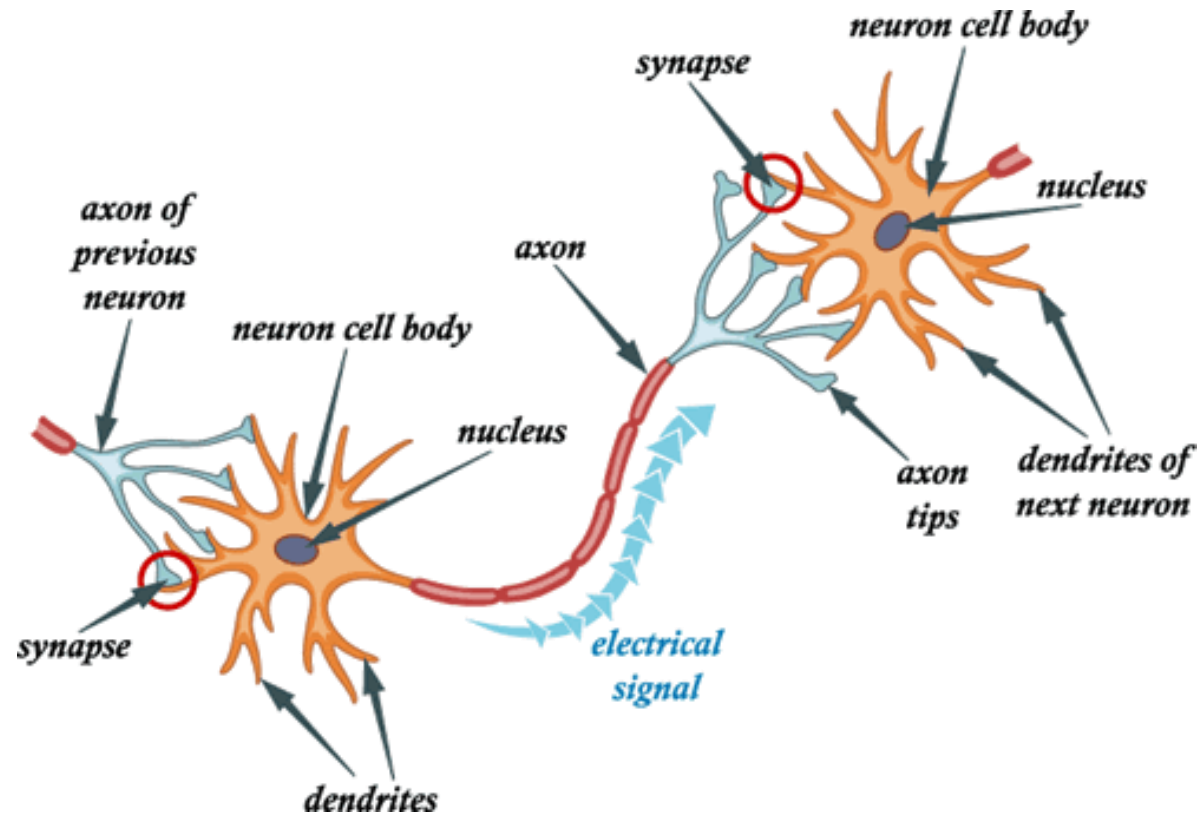
<http://www.alanjoneseducation.com/wp-content/uploads/2011/03/Tokuhama2.1-300x300.png>, adapted by the author.

# Neurodidactics – Aims

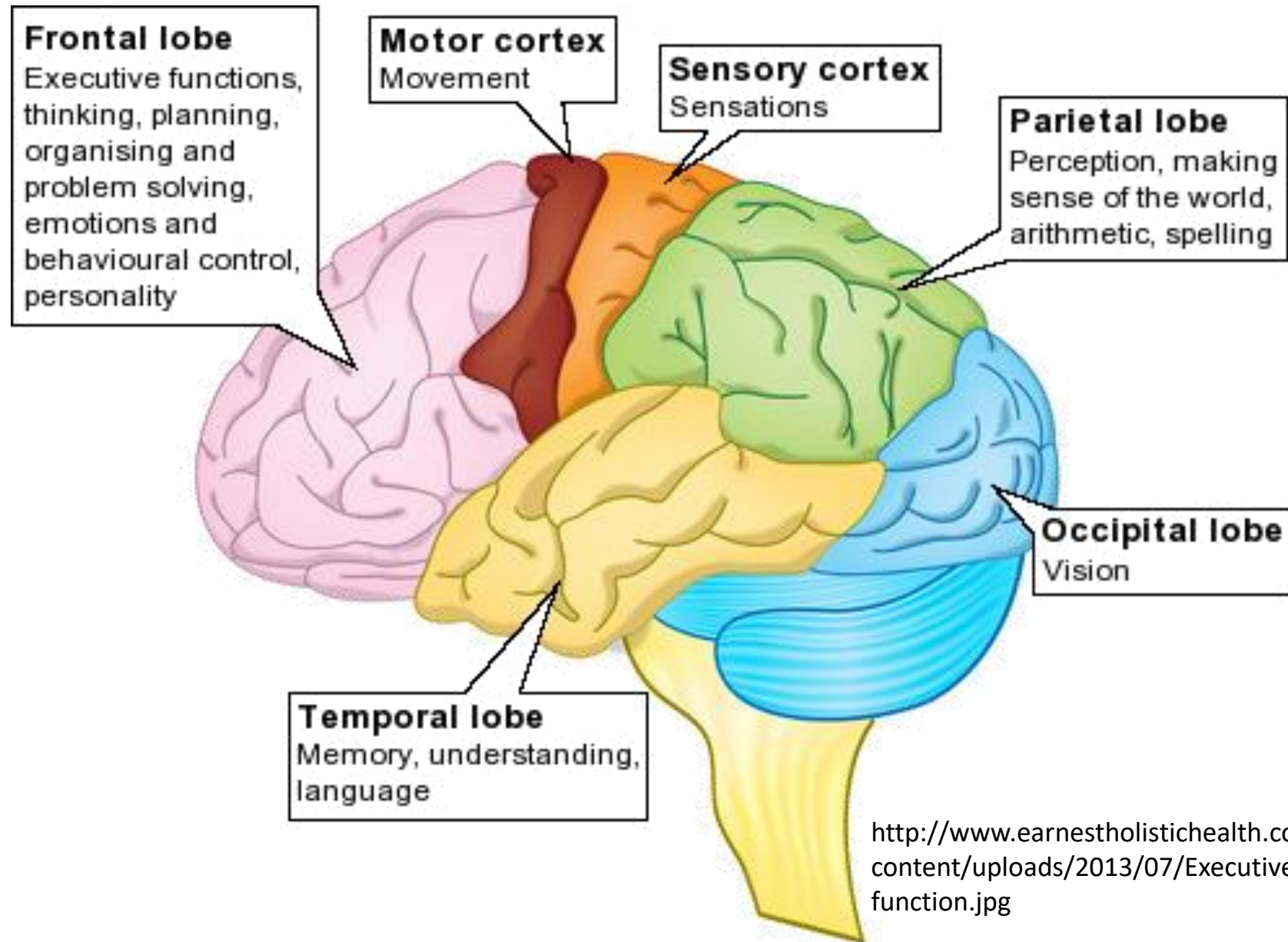
- Informing & Explaining
  - Learning brain
    - Brain areas
    - Brain functioning
    - Hormones & neurotransmitters
    - Role of emotions
    - Memory
  - Brain-friendly / -supporting learning
    - Principles & Proposals
    - Concepts & Methods
- Improving teaching & learning
  - Lesson structure
  - Teaching & learning methods
  - Task design
  - Assessment



# Learning & Brain

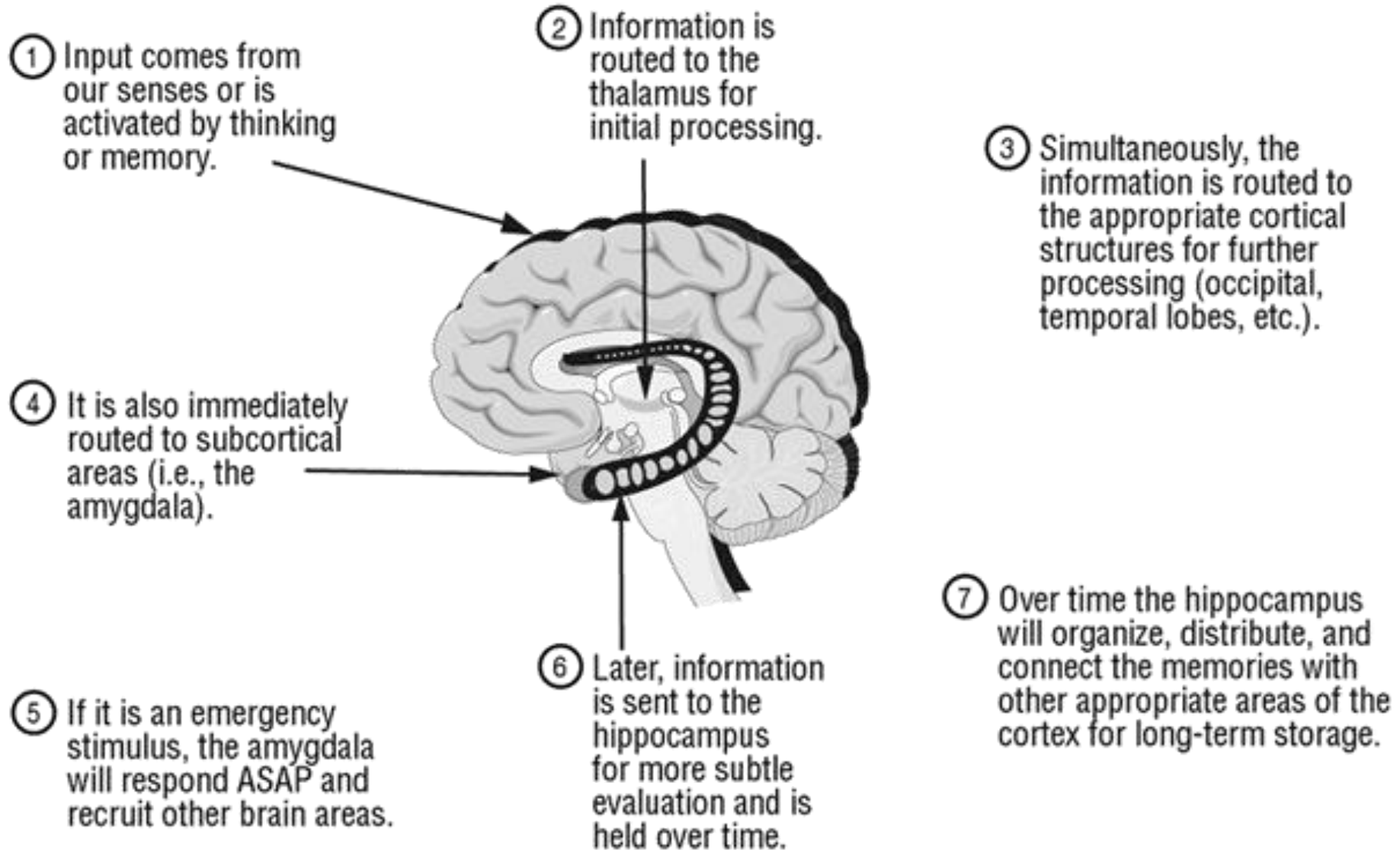


# Brain Areas



<http://www.earnestholistichealth.com/wp-content/uploads/2013/07/Executive-brain-function.jpg>

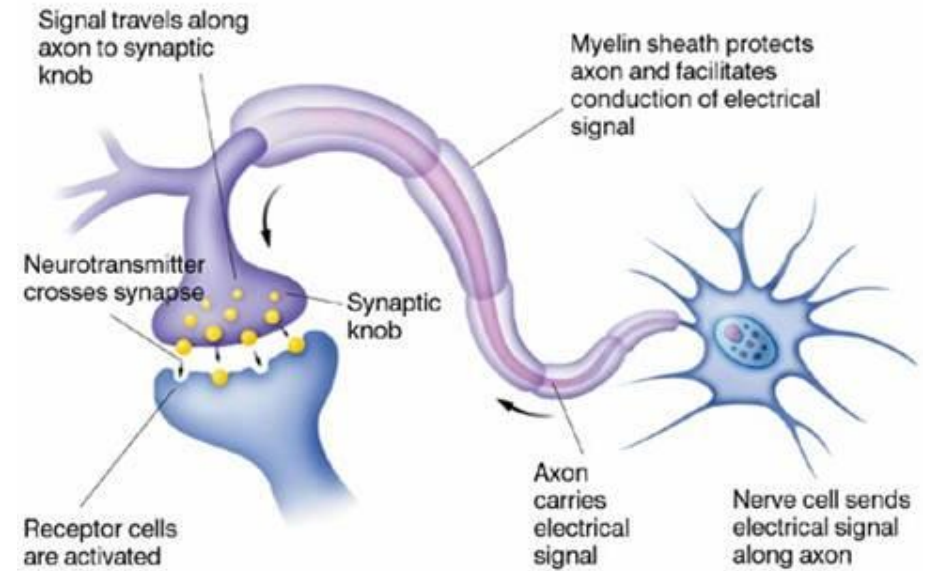
# Learning Brain



# Hormones & Neurotransmitters

Regulate motivation, interest, attention, learning capacity

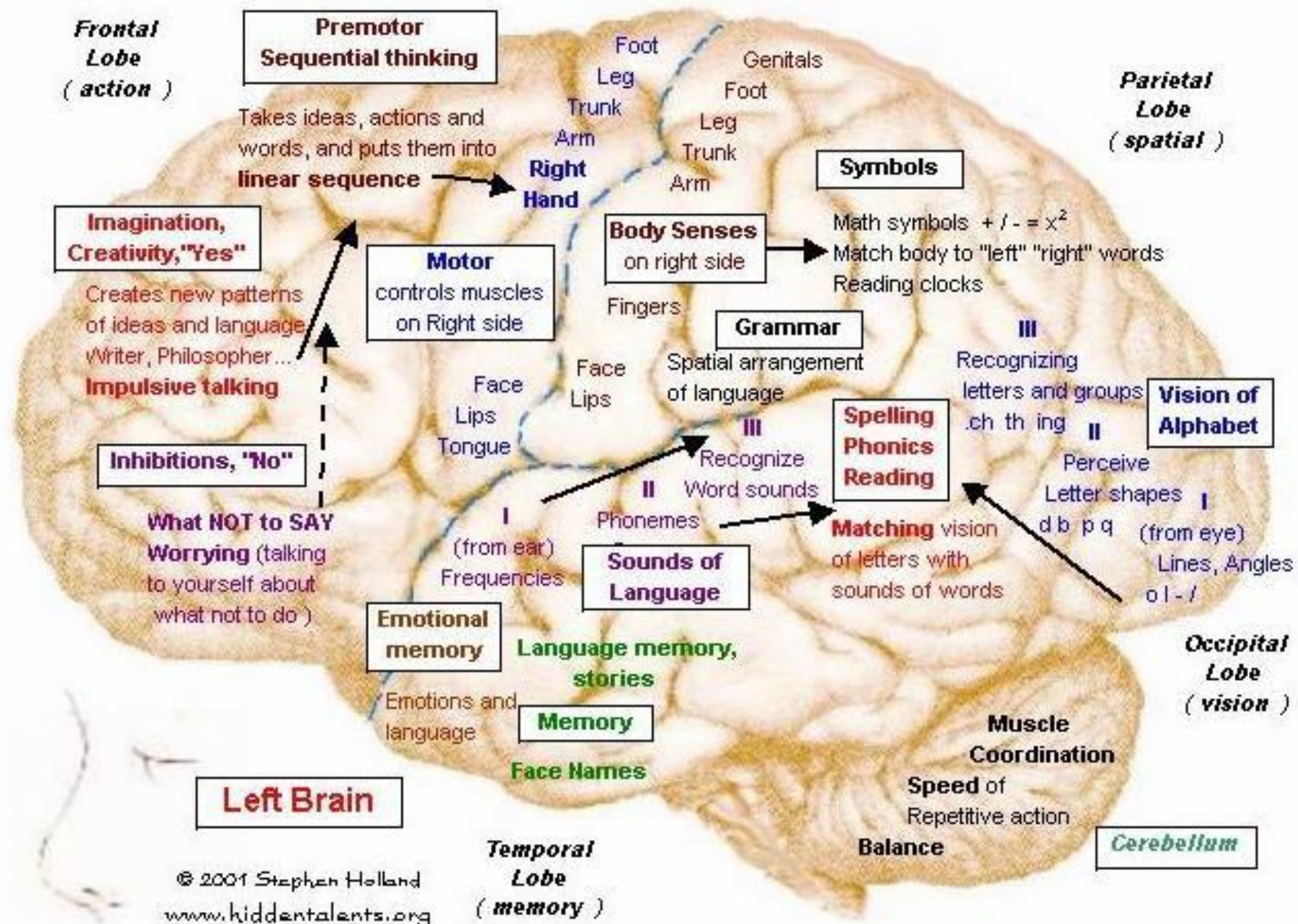
- Estrogens:
  - High level: verbal intelligence
  - Low level: spatial intelligence
- Testosterone: Memory
- Serotonin: “ feel good ” chemical
- Glutamate: Concentration, memory
- Acetylcholine: Fosters learning, selected attention
- Noradrenalin:
  - General attention, alertness, concentration
- Cortisol
  - Stress-hormone, low level – better memory
- Dopamine:
  - Stimulates motivation and pleasure centers



<http://jordan-tesch.wikispaces.com/Chapter+four>

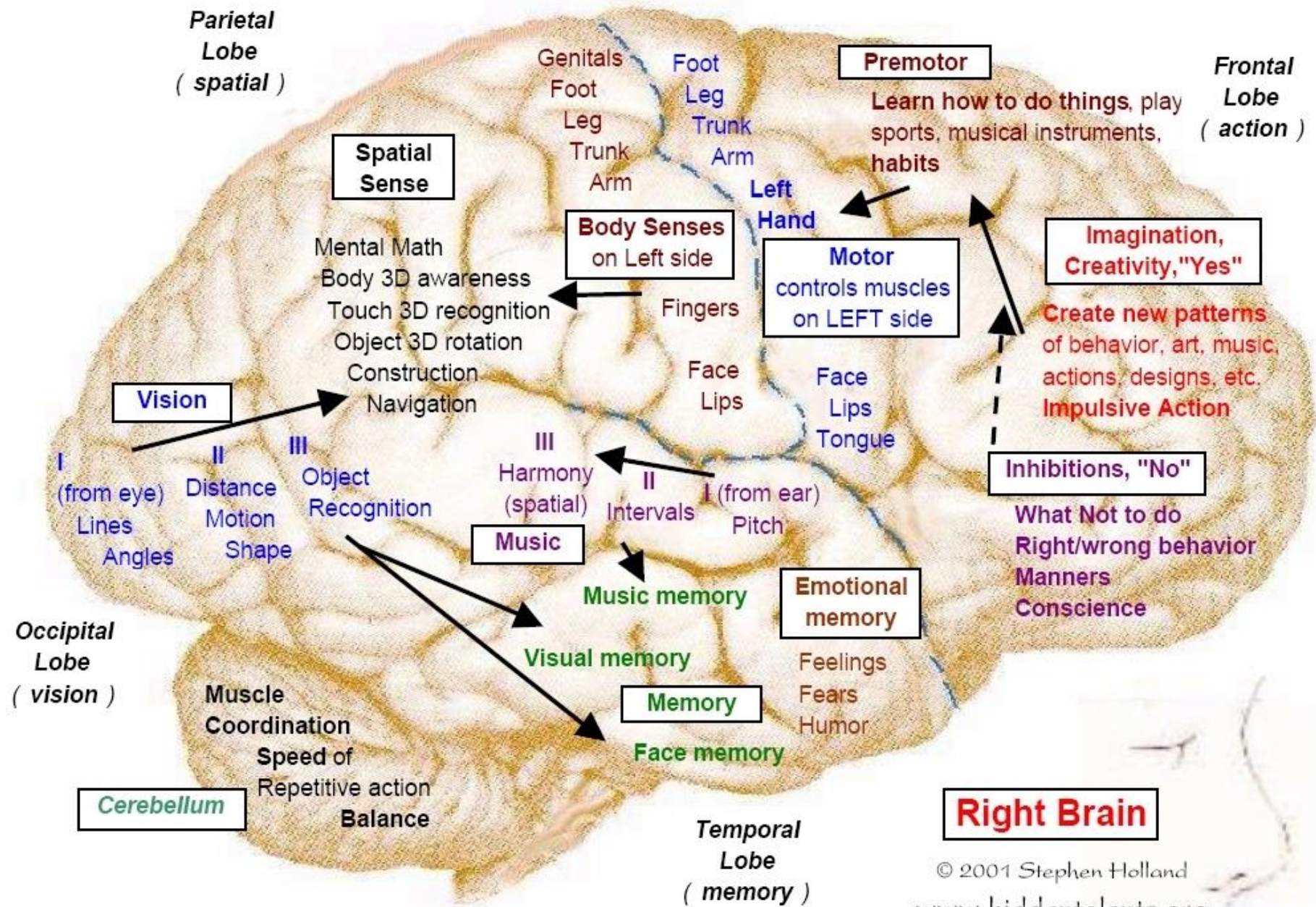


# Lef

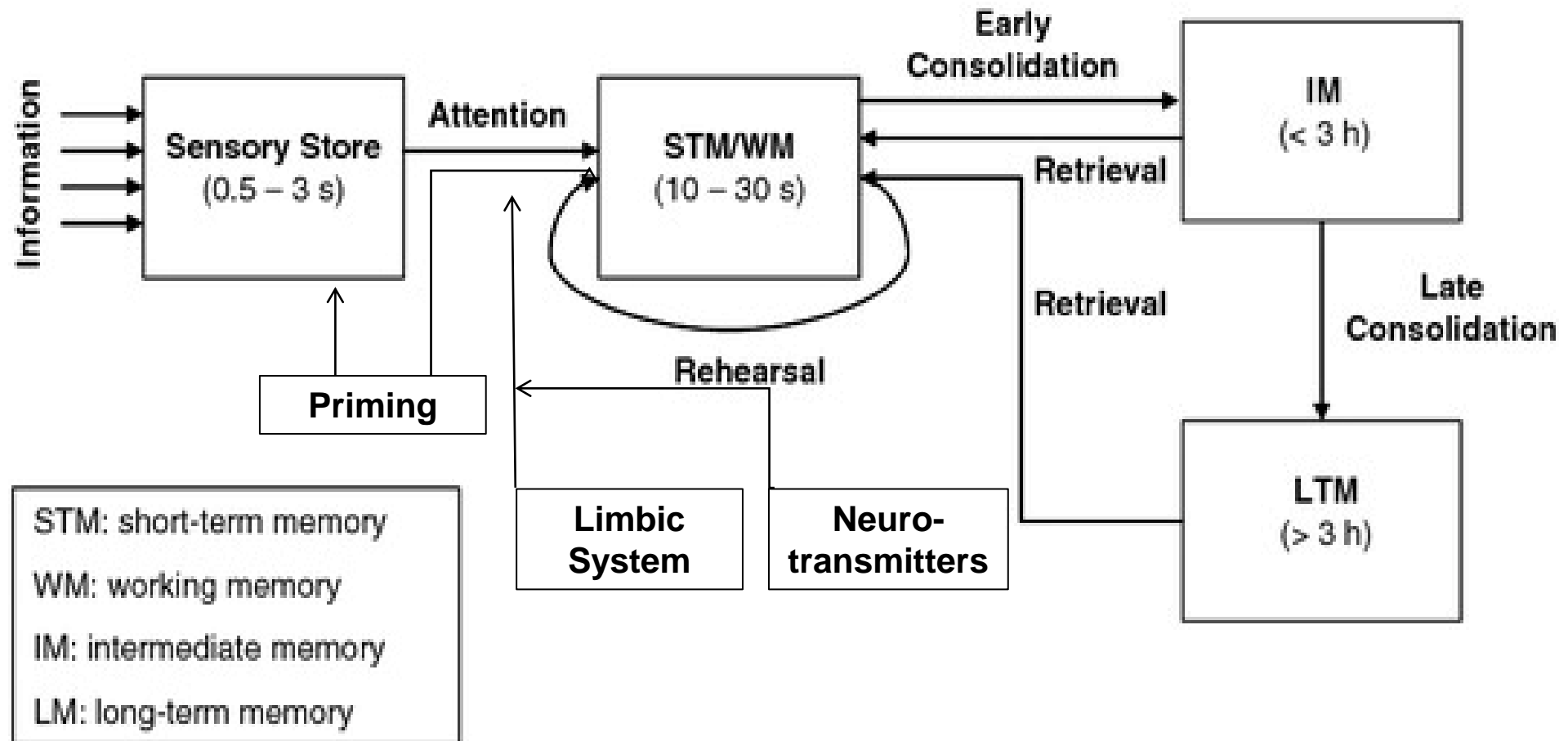




# Rig

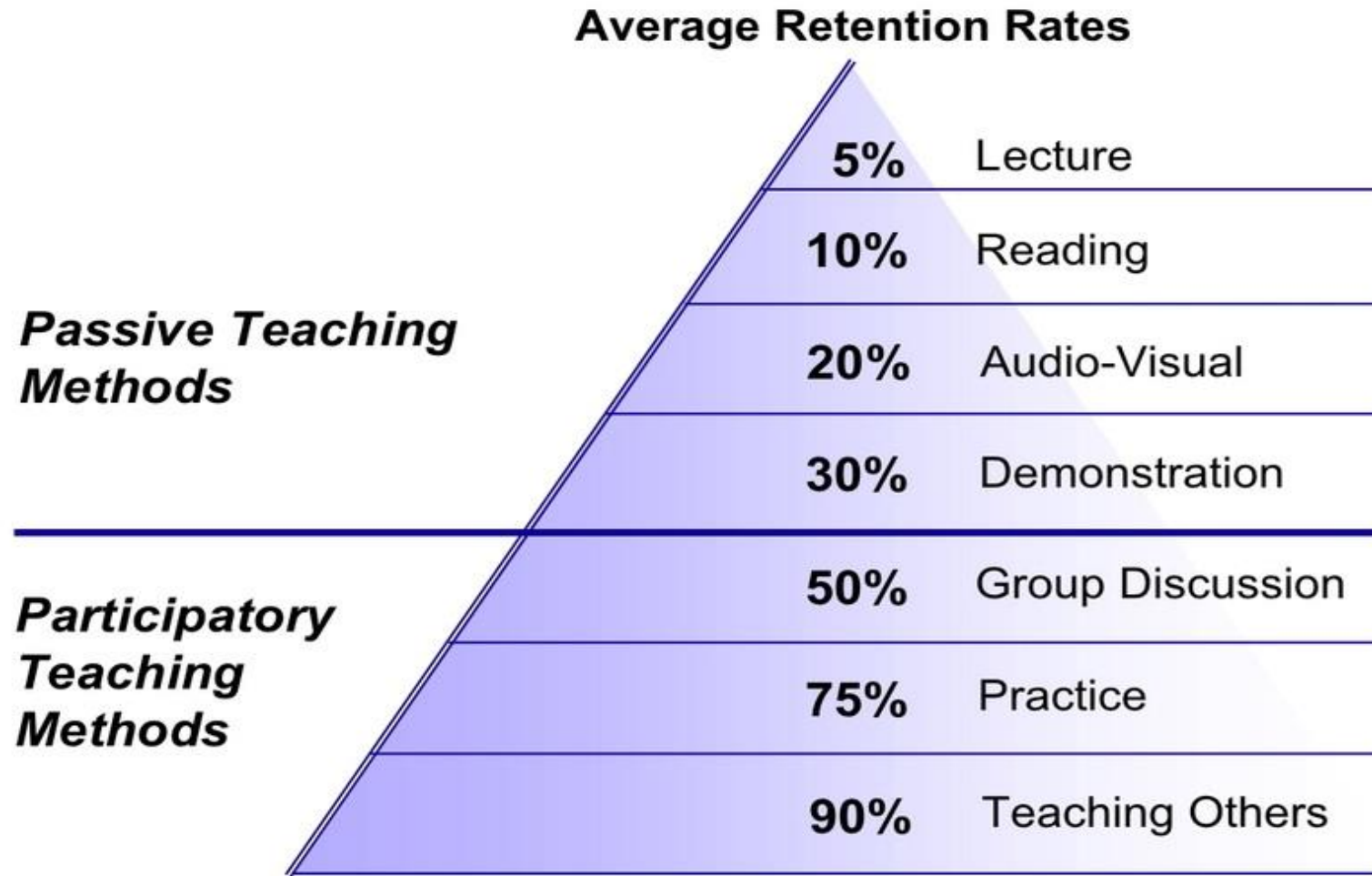


# Learning & Memory



Quelle: [http://www.springerimages.com/img/Images/Springer/PUB=Springer-Verlag-Berlin-Heidelberg/JOU=00213/VOL=2009.202/ISU=1-3/ART=2008\\_1273/MediaObjects/MEDIUM\\_213\\_2008\\_1273\\_Fig2\\_HTML.jpg](http://www.springerimages.com/img/Images/Springer/PUB=Springer-Verlag-Berlin-Heidelberg/JOU=00213/VOL=2009.202/ISU=1-3/ART=2008_1273/MediaObjects/MEDIUM_213_2008_1273_Fig2_HTML.jpg), adaptiert

# The Learning Pyramid\*



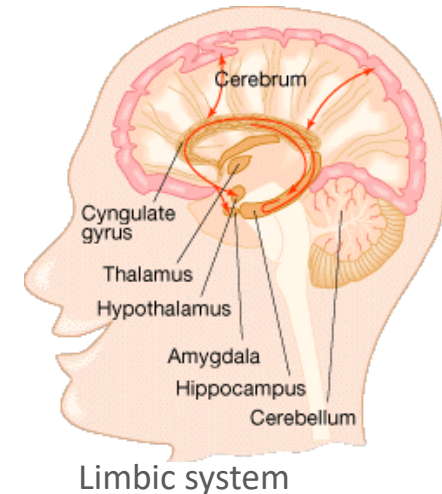
\*Adapted from National Training Laboratories. Bethel, Maine

[http://www.iceinstitute.org/uploads/1/0/9/8/10981999/9004064\\_orig.jpg](http://www.iceinstitute.org/uploads/1/0/9/8/10981999/9004064_orig.jpg)

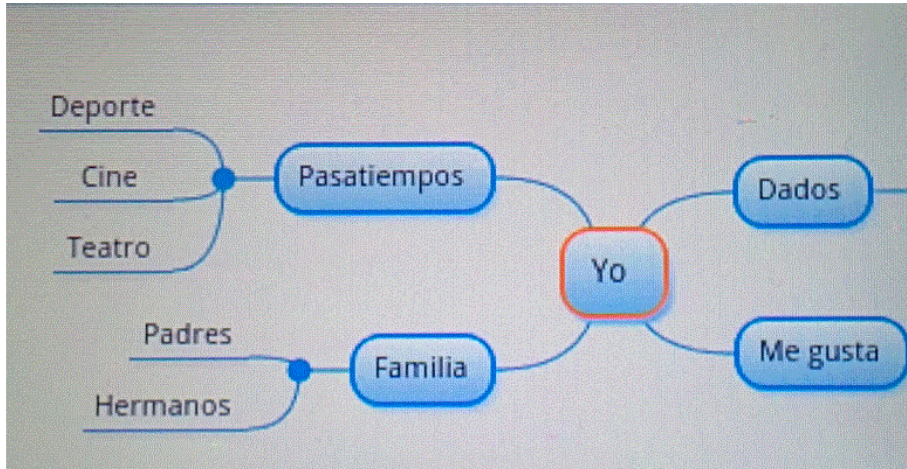


# Neurodidactics – Proposals

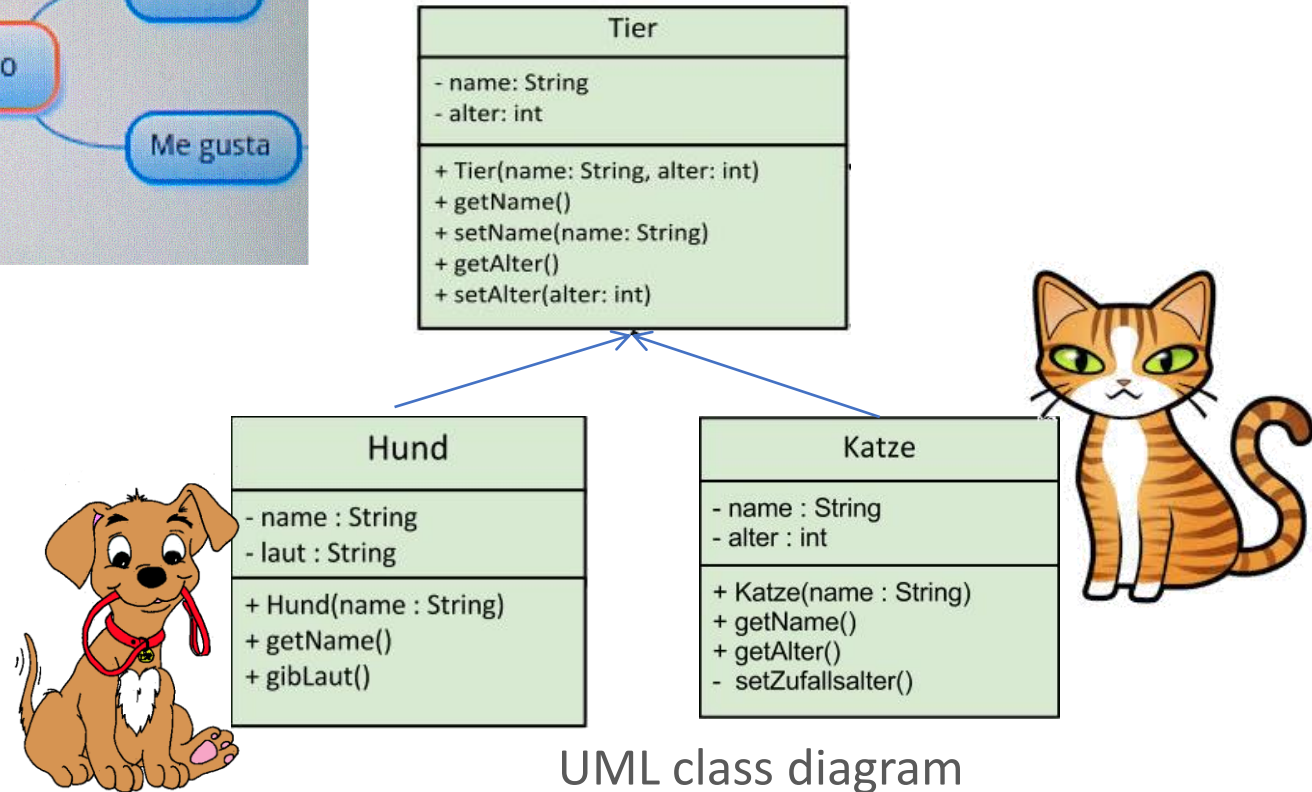
- Considering *biological facts*:
  - [Age](#), [gender](#), [hormones](#), neurotransmitters, limbic system etc.
  - Different tasks, roles, methods, approaches, material, topics,
- Influencing *personal facts*:
  - Motivation, attention, emotions, dopamine, adrenalin
  - Interesting & useful topics, products, games, competitions
- Creating *supportive environment*:
  - Lesson structure, [breaks](#), room, varied material, tools, ICT
  - COOL: COoperative & COmputer-supported Open Learning
- Supporting *brain functioning and memory process*:
  - Pattern recognition – discovery learning
  - Mirror neurons – observational learning,
  - Recall = new learning – learning by teaching, peer tutoring, cooperative learning
  - Cognitive effects e.g. primacy-recency, modality effect, priming



# Priming



Mindmap



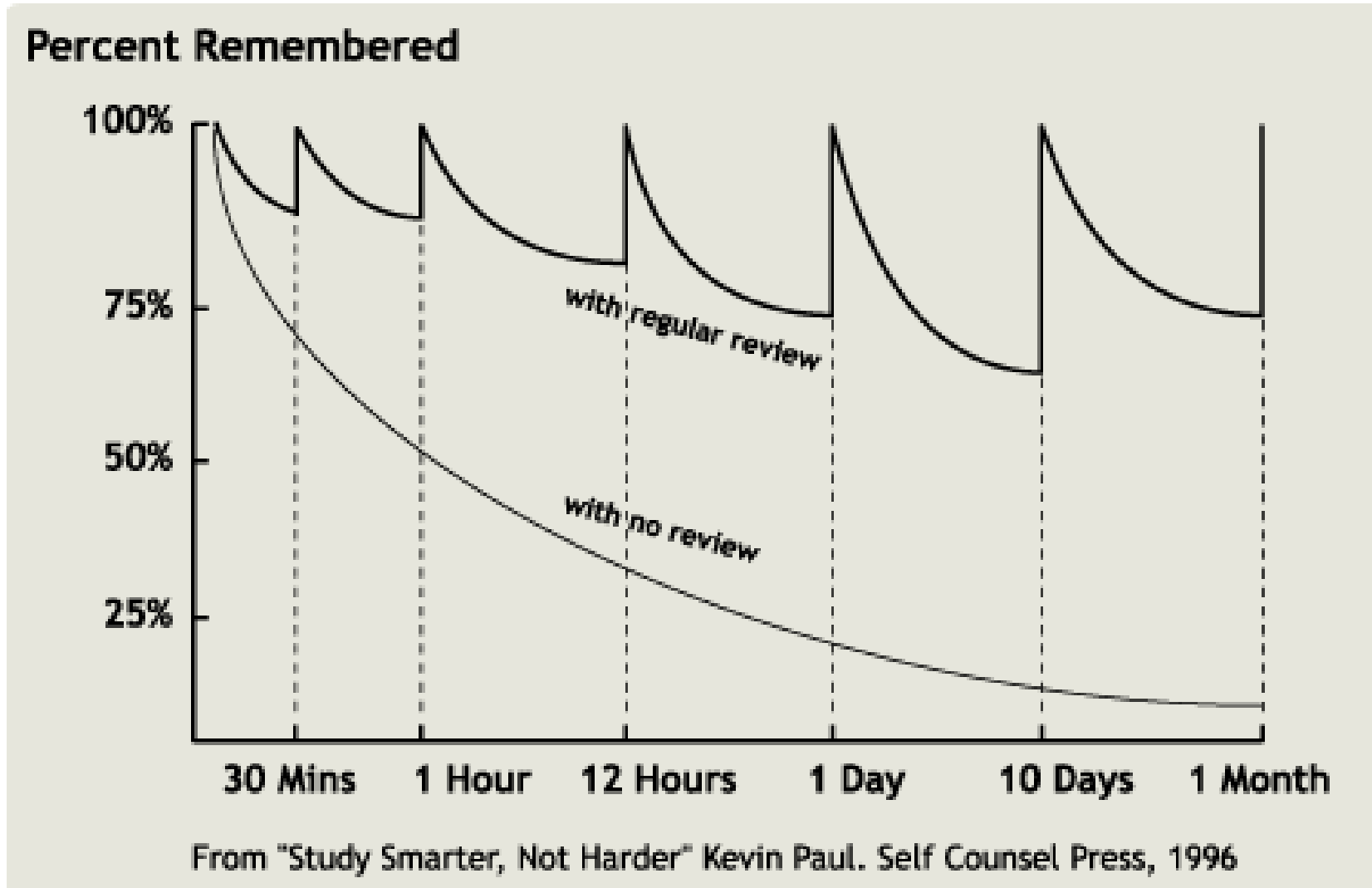
UML class diagram

# Neurodidactics – Principles

- Learning must make sense and have meaning!
  - Integrating individual interests, talents, needs, useful learning products, possibility of choice
- Discover your own knowledge!
  - Pattern recognition, rule extraction, examples, step-by-step instructions
- The brain is a mirror.
  - Observation, imitation, worked examples, sample solutions
- Double-coded = double-saved
  - Modality effect, multimedia, video tutorials
- Make connections!
  - Previous knowledge, examples of everyday life, mnemonics
- Generate your own knowledge! Be active!
  - Animation, simulation, learning by doing,
- Make a Break! Brain needs time for consolidation, individual rhythm
- Learning by teaching: Cooperation, Recall = restart of memory process = new storage



# Forgetting & Remembering





# LUS – Learning Under Self-Control

- *Activation* (10 minutes):  
At the beginning relaxation exercises prepare the students for the learning process and **focus** their **attention**.
- *Presentation* (5-10 minutes):  
The **key-information** of the new learning contents is presented.
- *Consolidation I* (5 minutes):  
A little **break** of 5 minutes shall facilitate the consolidation of the new contents.
- *Repetition I* (5 minutes):  
Now **the key-information** is repeated for a first time.
- *Consolidation II* (10 minutes):  
A second **break** shall foster the consolidation of the repeated contents.
- *Repetition II* (10 minutes):  
A second repetition shall lead to a better and deeper memory-processing and **storage**.

# COOL = cool

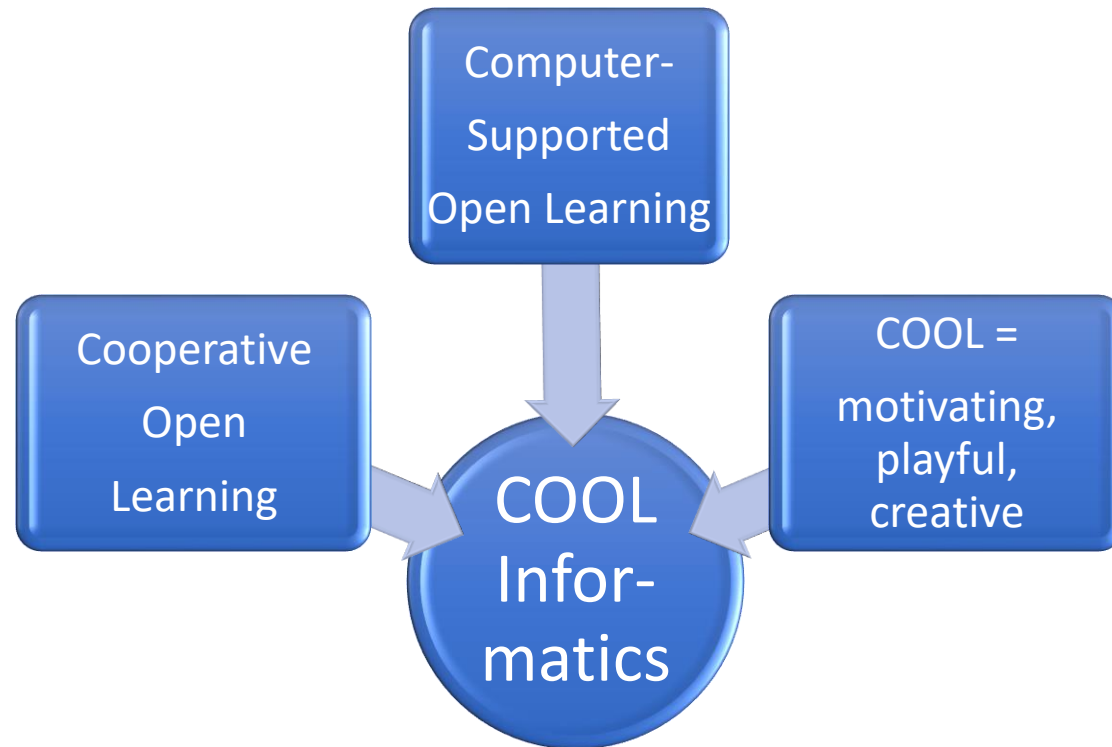
- cool
  - Interesting and motivating
  - Useful and meaningful
    - Integrating individual needs, talents and interests
    - Topics and learning products that can be used in real life
  - Fun and playful
    - Playing and designing games
    - Animation and simulation
    - Competitions
    - [Music](#)...
  - Creative and active
    - Students create own quizzes, puzzles, games, exercises with solutions
  - Brain-supporting and effective



# COOL Informatics

- Combining all meanings of COOL

- Lesson structure
- Teaching methods
- Teaching material
- Activities and tasks
- Input and Topics
- Environment
- Tools and software
- Cooperation form
- Learning products
- Assessment



# COOL IT – Teaching Approach



## 1. Discovery

### Teaching and learning methods:

Solution-based learning  
Step-by-step instructions & tasks  
Video tutorials  
Observational learning  
Learning with all senses

### Neurodidactical base:

Pattern recognition  
Mirror neurons  
Individual learning rhythm  
Modality/multimedia effect



## 2. Individuality

### Teaching and learning methods:

Competence-based learning  
Questioning  
Self-organized learning with compulsory and optional tasks

### Neurodidactical base:

Connecting new information to previous knowledge.  
Considering individual interests, needs, tasks, methods, learning rhythm



## 3. Cooperation

### Teaching and learning methods:

Team and group work  
Peer tutoring and teaching  
Pair programming  
Cross-curricular learning  
Project-based learning

### Neurodidactical base:

"A joy (= knowledge) shared is a joy (= knowledge) doubled."  
Recall = re-storage in memory  
Integrating individual needs, talents, competences,  
Practical relevance



## 4. Activity

### Teaching and learning methods:

Hands-on, mind-on  
Learning by doing  
Learning by animation, simulation by playing and designing games (creative learning)

### Neurodidactical base:

Knowledge must be created (constructed) by each learner (= constructivism)  
Learning is an active process (= progressive education, e.g. Montessori)

(Sabitzer, Groher, & Sametinger, 2020; Sabitzer, 2014)