

# Adapting Teaching Strategies to Brain Development

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# How the Brain Learns and Remembers

## Learning = Growth Of Dendrites

- Fibers that grow out of neurons or brain cells.
- Grow only when you do something active.
- Dedicated to the activity that caused them to grow.
- Can't grow in a void; must connect to something which is already there.
- Practice or repetition needed.

## Effects of Practice on Learning

- With practice, a myelin coating forms around dendrites allowing connections to work faster and with less effort.
- Without practice, connections break down.

## Building Practice into Lecture

- Students need practice solving problems before they leave class.
- Interactive lectures.
  - Ask a lot of questions.
  - What should we do next?
- Expect students to apply what they have already learned.

## Include Assessment in Lecture

- Formative assessment needed.
  - Faculty must assess student understanding and correct student errors during class.
  - Otherwise mistakes are propagated in the homework.
- Get out of class problem.

## Communicate Differences Between High School and College

- Material covered six times as fast as in HS.
- New section covered every day.
- Limited in-class time for reviewing previous lectures or completing assignments.
- Develop study habits that lead to doing more rather than less.

## Communicate Expectations

- Mathematics involves the learning of facts, processes, and concepts.
- Students will be held accountable for all concepts taught.
- Students must use correct vocabulary and notation.
- Each student is responsible for his or her own learning.
- Explain the benefits of homework, practice tests, etc.

## How Emotions Affect Learning

- Fear causes adrenalin to flow through the brain and block connections.
- Exercise and laughter cause endorphins to flow through the brain and enhance connections.

## A Sense of Community Reduces Fear

- Students need to feel connected.
  - They often feel they are the only ones having trouble with math.
  - Students work in groups.
- Students want approachable instructors.
  - I can help you learn, rather than I can teach you.
- If students feel at ease, they learn better.

## Physiological Changes in the Young Adult Brain Ages 18-20 (often until age 25)

## Young Adult Brain Change #1

Overproduction of connections followed by pruning of unused connections.

## Effects on Behavior

- Seek out novelty, emotion, surprise and unpredictability.
- Need structure and organization.
- The things they spend time on (whether good or bad) influence what they know, what they do, and who they are as adults.

## What We See in Our Classes

- Short attention span.
- Like to be entertained.
- Ask for lots of specific guidance.
- Seem not to be independent.

## What We Can Do To Help

- Provide short breaks.
- Use new ideas and techniques.
- Don't be too predictable.
- Provide structure and guidance.
- Give quick feedback.
- Be explicit.
- Model behaviors you wish them to exhibit.

## Young Adult Brain Change #2

The center of “executive functions” such as reasoning, language, planning, and impulse control develops last.

## Effects on Behavior

- Respond emotionally rather than logically.
- Have trouble anticipating the consequences of their behaviors.
- May have difficulty in expressing themselves clearly, especially when frustrated.
- Have difficulty hypothesizing, analyzing, and drawing conclusions.

## What We See in Our Classes

- Emotional responses.
- Being defensive.
- Lack of clarity.
- Not logical.
- Act before thinking.

## What We Can Do To Help

- Be patient.
- Don't take an outburst personally, but explain why it is inappropriate.
- Model behaviors you want to see in students.
- Describe your own reasoning steps out loud so students hear them.

## Young Adult Brain Change #3

Bridge between brain's hemispheres grows larger and thicker.

## Effects on Behavior

- Most mental tasks require communication between both hemispheres.
  - As development occurs, students are able to handle more complex tasks.
- The sense of self seems to be located in the right hemisphere and the sense of others in the left hemisphere.
  - As development occurs, students are better able to relate to others.

## What We See in Our Classes

Students who have not fully developed in this area:

- May seem one sided.
- Can't see others points of view.
- Don't realize how others view them.
- Don't see how their actions affect others.
- May have difficulty with complex problems.

## What We Can Do To Help

- Explain how a student's behavior affects others.
- Give feedback on accepting the point of view of others.
- Whenever possible, break down complex tasks.

## Brain Facts to Remember

- Works in periods of intense focus, followed by periods of low levels of attention.
- Working memory can process  $7 \pm 2$  new pieces of information.
- Responds to rhythms, patterns, cycles, colors.
- Learns by repetition, but not rote learning.
- Threat, high anxiety, or a sense of impending failure inhibit or prevent learning.

## My Conclusion

The best instructional strategies promote learning compatible with the way the brain functions.