

# Your Brain, Their Brain: What you need to know

Laura Carruth

Georgia State University

Anna Higgins-Harrell

Gordon State College

Rebecca Johnston

University of North Georgia

Stacy Kluge

Augusta University

Joyce Weinsheimer

Georgia Institute of Technology



## Session Goals

- ▶ Identify how an FLC might use neuroscience to explore and enhance student learning
- ▶ Highlight how faculty brains and student brains differ
- ▶ Introduce brain-based teaching strategies that address learning challenges our students encounter





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# Case Study

So Much Content,  
So Little Time






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# Introduction



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The brain of a typical first-year college student is more similar to:

the brain of a middle school student

OR

the brain of a 25 year old



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According to neuroscientists at Dartmouth, “the brain of an 18-year-old first year student is still far from resembling the brain of someone in their mid-twenties,” (Baird & Bennett, 2005)

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Is the Frontal Lobe important?

- reasoning
- planning
- parts of speech
- movement
- emotions
- problem-solving



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<https://www.koshland-science-museum.org/explore-the-science/interactives/brain-anatomy>

## Growing a Grown-up Brain

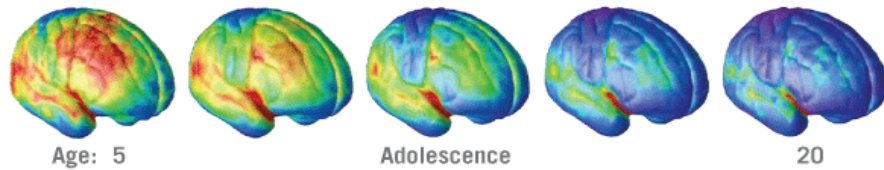
Scientists have long thought that the human brain was formed in early childhood. But by scanning children's brains with an MRI year after year, they discovered that the brain undergoes radical changes in adolescence. Excess gray matter is pruned out, making brain connections more specialized and efficient. The parts of the brain that control physical movement, vision, and the senses mature first, while the regions in the front that control higher thinking don't finish the pruning process until the early 20s.

**Gray matter density**

Gray matter becomes less dense as the brain matures.



More dense      Less dense



**Gray matter:** Nerve cell bodies and fibers that make up the bulk of the brain's computing power.

**Parietal lobe:** Spatial perception

**Occipital lobe:** Vision

**Temporal lobe:** Memory, hearing, language

**Frontal lobe:** Planning, emotional control, problem solving

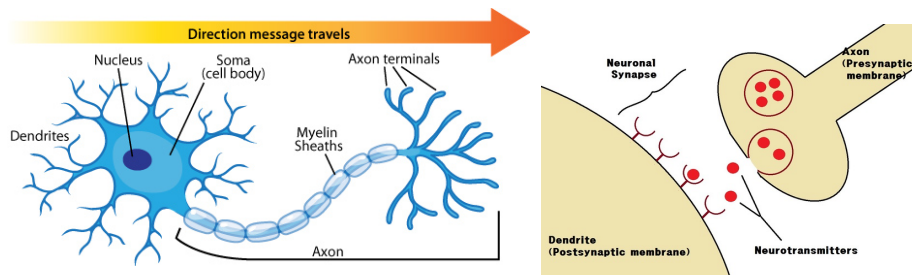
Source: "Dynamic mapping of human cortical development during childhood through early adulthood," Nitin Gogtay et al., *Proceedings of the National Academy of Sciences*, May 25, 2004; California Institute of Technology



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## Neurons

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Synapse: the junction between two neurons



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## Five-minute neuroscience lesson: How does the brain learn new content?

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- ▶ Neurons
- ▶ Thalamus
- ▶ Amygdala
- ▶ Frontal lobe
- ▶ Hippocampus



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## How does the brain make memories?

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- ▶ The brain forms long-term memories depending on the number of times an event or fact is repeated
- ▶ Repetition causes neurons to make connections and to strengthen existing connections with other neurons (neuroplasticity)



Image from Medical News Today



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## Memory and Learning

- ▶ Learning: a process yielding an adaptive change in behavior that results from experience
- ▶ Learning requires memory: the encoding (input), storage & retrieval of information (about past experience)



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## Discussion of Three Stages of Memory Formation

- ▶ Part 1: Encoding (input)
- ▶ Part 2: Storage
- ▶ Part 3: Retrieval



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## Part I: Encoding

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## Activity



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## Encoding and Attention: Preparing the brain to learn

- ▶ Organization
  - How do you organize your content so that students can interact with it?
  
- ▶ Basic Needs
  - How do you encourage students to eat, exercise, and sleep so that their brains can function efficiently?



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## Encoding: Priming and prior knowledge

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- ▶ Build on what your students already know
  - Use pre-assessment/formative surveys, quizzes
- ▶ Guide student interactions with the course material
  - Ask students to make predictions
  - Use guided notes during class
- ▶ Identify misconceptions
  - Help students “un-learn” incorrect information

## Encoding: Rehearsal & Practice

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- ▶ Build in opportunities for students to practice new information.
  - Annotate a worked problem to explain reasoning.
  - Distribute practice, repeating and reinforcing concepts as new material is added.
  - Apply a new concept to an example (e.g. case study).
  - Align the difficulty of practice with the exam.



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## Part II: Storage

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## Storage: Processing

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- ▶ Meaning is Constructed
  - ▶ 1. Incubation Period
  - ▶ 2. Brain Breaks
  - ▶ 3. Sleep



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## Storage and Organization

► In class:

Use first 5 minutes and last 5 minutes as book ends.

Use Whole-part-whole (Example: big-picture, detail, big-picture).

► *TILT* your assignments (another FLC topic).



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## Storage: Modeling and Scaffolding

► Modeling (mirror neurons)

► Students learn by seeing examples of what you do AND don't want them to do

► Working through examples (especially those that increase in complexity) supports long-term memory formation

► Scaffolding

► Break major assignments up into small, workable units that build on each other (Supports executive decision-making)



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## Storage: Elaboration and Application

- ▶ Active learning in class:
  - ▶ Think-pair-share
  - ▶ Minute Papers
  - ▶ Debate and discussion
- ▶ Larger scale class activities:
  - ▶ Project-based learning
  - ▶ Reacting to the Past
  - ▶ Research or service-learning projects



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## Part III: Retrieval




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rest	doze	snore	bed
tired	wake	nap	dream
snooze	drowsy	yawn	blanket

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## Retrieval: How can we help students be successful?

- ▶ Avoid confabulation.
- ▶ Use varied assessments.
  - Fact-based, concept-based, complex questions
  - Multiple-choice, short answer, short essay, self-quizzing, summarizing
  - Consider frequent low-stakes practice such as quizzes before or during class
  - Provide frequent and useful feedback

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## Retrieval: What works?

- ▶ Sleep is important for learning-- memory consolidation occurs during REM and non-REM sleep
- ▶ Good diet, exercise, and stress-reduction activities contribute to learning.
- ▶ Recognition that new learning requires a considerable amount of practice and a meaningful connection to other information in order to become a permanent part of memory.



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Based on all of this information, what teaching strategies fail to support student learning?

- ▶ One mid-term/final class format
- ▶ One big paper assignment
- ▶ Strict lecture or info “dump” format
- ▶ No time to use (and rehearse) information/concepts
- ▶ No modeling
- ▶ Lack of organization in lecture/class/course
- ▶ Lack of timely or effective feedback



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Based on all of this information, what teaching strategies promote student learning?

- ▶ How might you **open class** to set the stage for the day's content?
- ▶ What might you **do during class** to help students practice using new information?
- ▶ How might **you end (or follow up) class** that reinforces what students have just learned?



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## Case Study

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## Next Steps: Using neuroscience to enhance student learning

- ▶ Teaching strategies that resonate with me include:
  
- ▶ Possible topics I'd like to pursue further in a faculty learning community include:



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