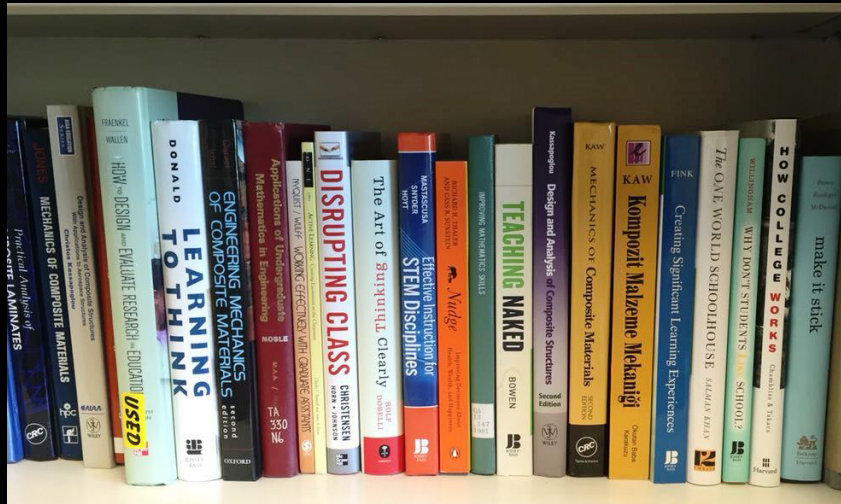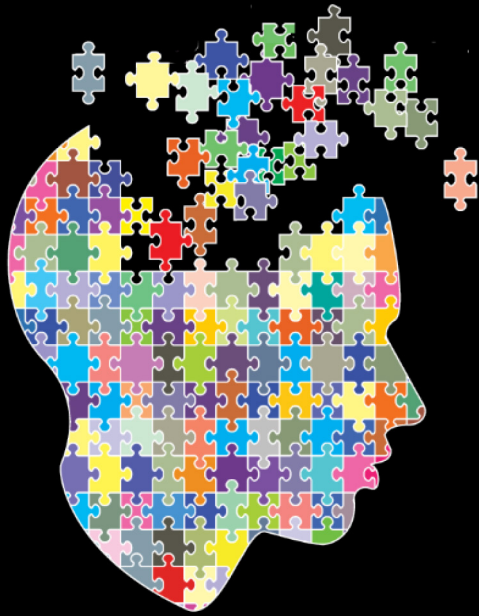# Improving Student Success in An Engineering Course

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"All discussion of reform must begin with the ordinary student, not the genius, not the prospective scientist or professor of abnormal psychology but the citizen of the republic who must earn a living in addition to living a humane life." – Paige Smith, *Killing the Spirit: Higher Education in America*, 1990, p. 200

"Though we teach in front of students, we almost always teach solo, out of collegial sight – as contrasted with surgeons or trial lawyers, who work in the presence of others who know their craft well. Lawyers argue cases in front of other lawyers, where gaps in their skill and knowledge are clear for all to see. Surgeons operate under the gaze of specialists who notice is a hand trembles, making malpractice less likely. But teachers can lose sponges or amputate the wrong limb with no witnesses except the victims."

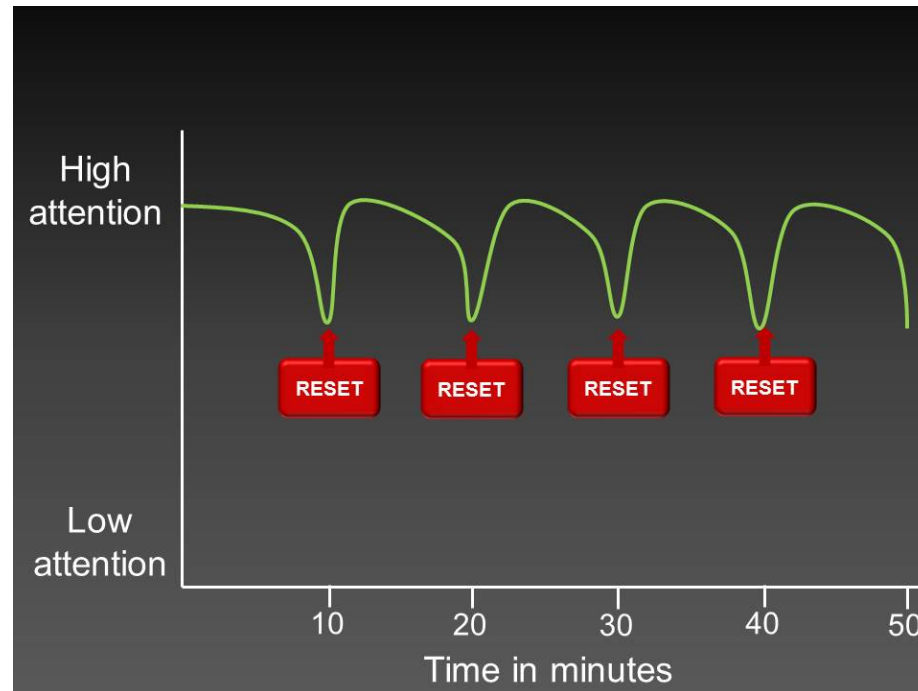*The Courage to Teach* (Parker Palmer, 2007, p. 146)

Given a 50 minute class that is of medium interest to a student, approximately at what time does the attention wane and stay waned

(A) 5 minutes
(B) 10 minutes
(C) 25 minutes
(D) 40 minutes

Attention vs. Time Elapsed
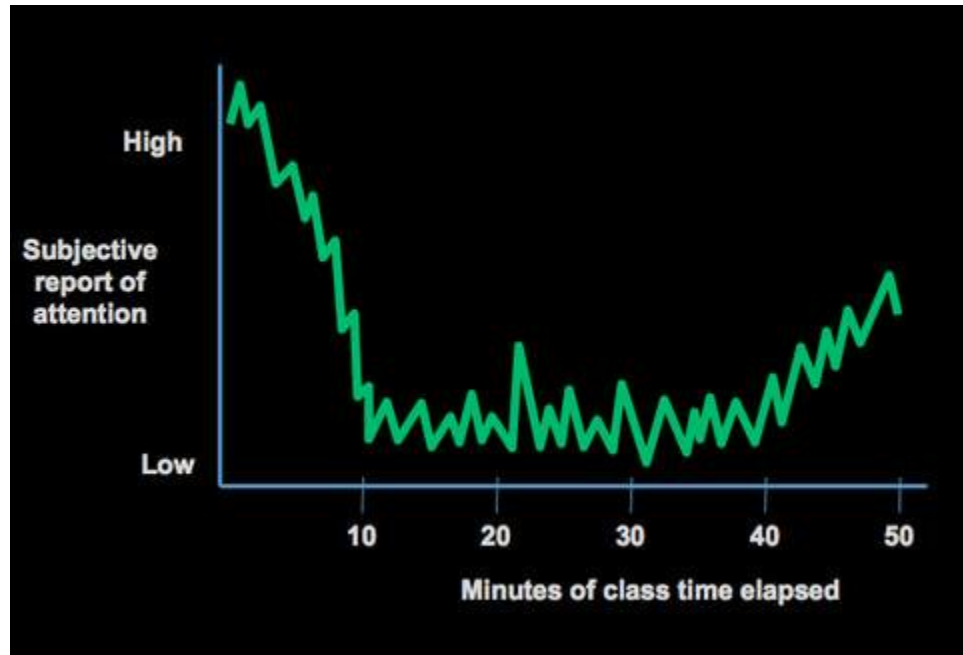
Resetting the Attention

What to do when you're losing your audience

Reflection Exercise

What simple 1-2 minute exercises can we use in the classroom for active learning?

Active Learning Strategies   Interactive Techniques

# Student's Prior Knowledge Can Help or Hinder Learning

Misconceptions

- **Preconceived notions**
- **Nonscientific beliefs**
- **Conceptual misunderstandings**
- **Vernacular misconceptions**
- **Factual misconceptions**

We have winter season because

A. the earth is farther from the sun in the winter than in the summer

B. of the tilt of the earth about its' axis

C. the earth is not a perfect sphere

D. the earth's orbit is not a perfect circle

Why do we have seasons?
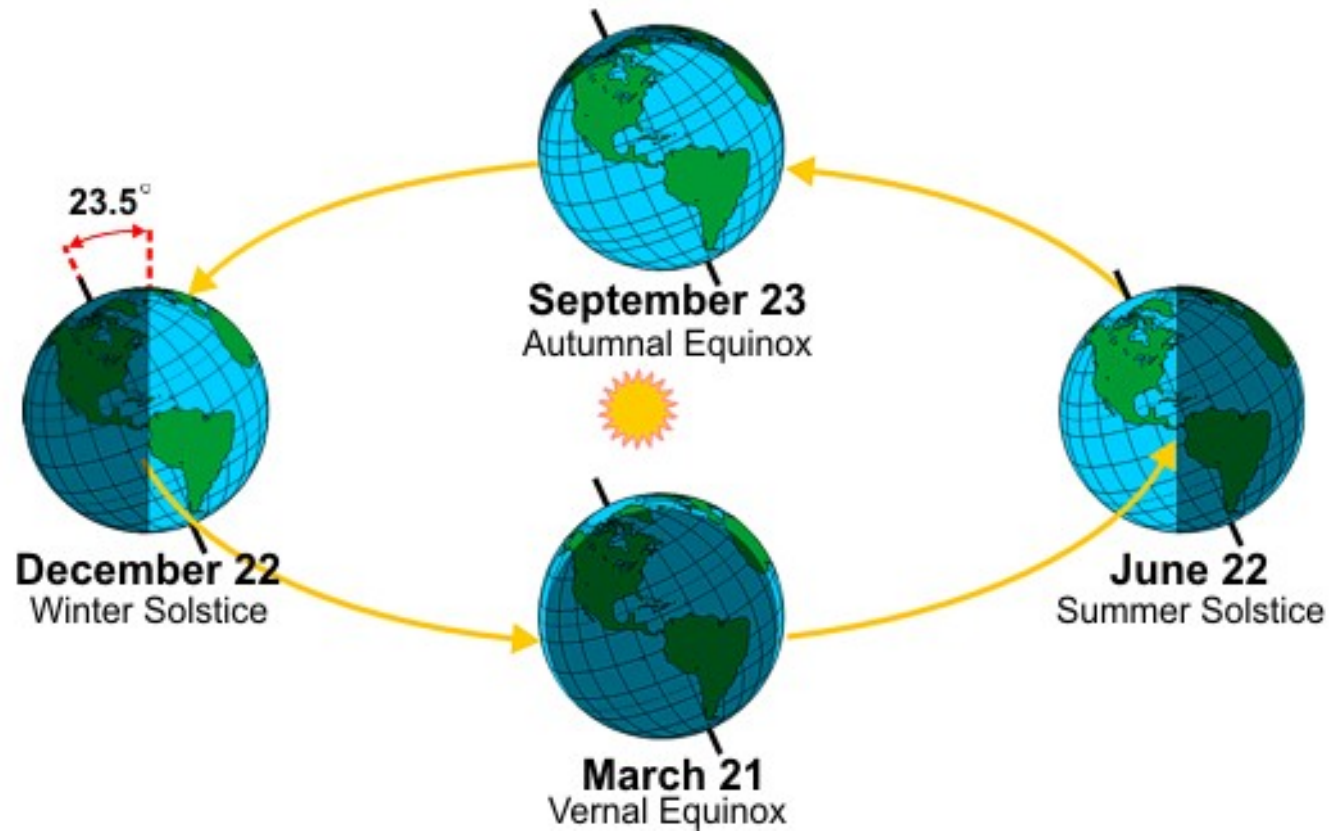
Reflection Exercise

Write one misconception students have in your favorite class? What can you do to remove such misconceptions?

Which Learning Techniques are Best?

Ten Common Learning Techniques

1. Elaborative interrogation
2. Self-explanation
3. Summarization   Low
4. Highlighting/underlining   Low
5. Keyword mnemonic   Low
6. Imagery for text   Low
7. Rereading   Low
8. Practice testing
9. Distributed practice
10. Interleaved practice

Ten Common Learning Techniques

1. Elaborative interrogation   **Moderate**
2. Self-explanation   **Moderate**
3. Summarization   Low
4. Highlighting/underlining   Low
5. Keyword mnemonic   Low
6. Imagery for text   Low
7. Rereading   Low
8. Practice testing
9. Distributed practice
10. Interleaved practice   **Moderate**

References for Learning Strategies

- Strengthening the Student Toolbox
- Original paper by Dunlosky

Ten Common Learning Techniques

1. Elaborative interrogation   Moderate
2. Self-explanation   Moderate
3. Summarization   Low
4. Highlighting/underlining   Low
5. Keyword mnemonic   Low
6. Imagery for text   Low
7. Rereading   Low
8. Practice testing   High
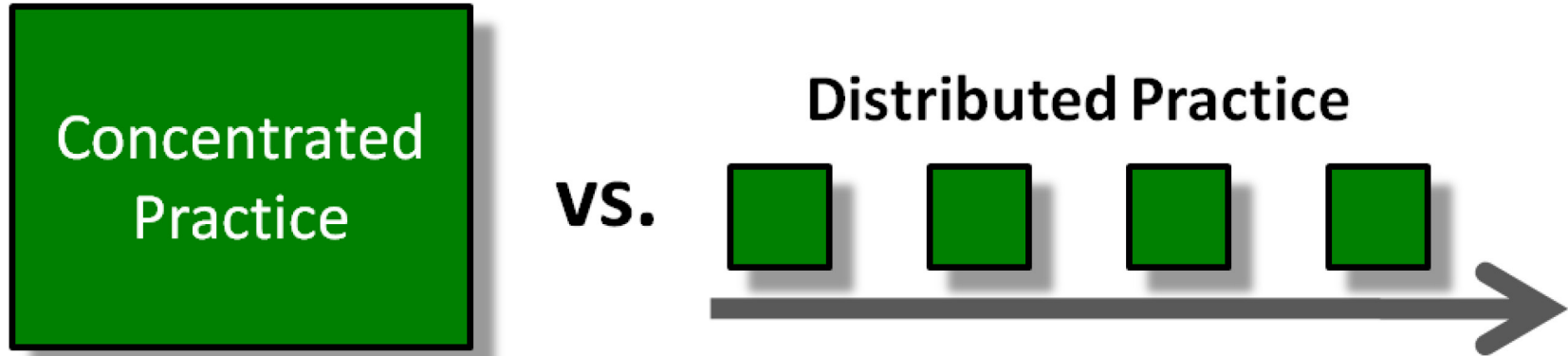9. Distributed practice   High
10. Interleaved practice   Moderate

Practice Testing

Effect size, d=0.74
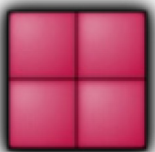
$$d = \frac{\mu_1 - \mu_2}{s}$$

Distributed Practice

Concentrated Practice **vs.** Distributed Practice

Effect size=0.46
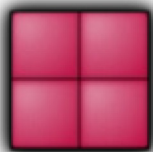
Block and Interleaved Practice
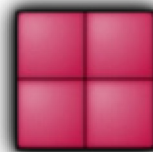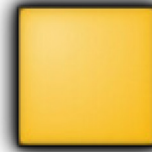
BLOCKERS

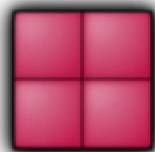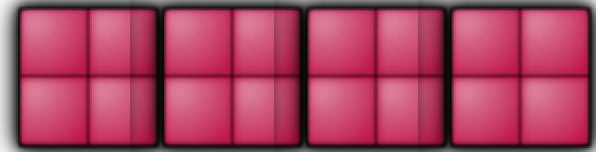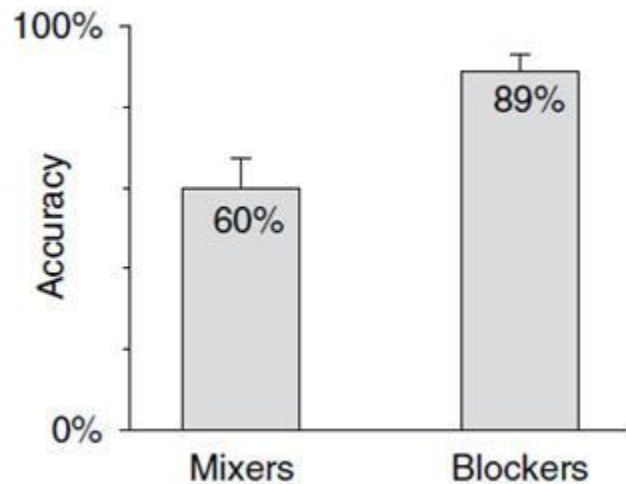Tutorial 1   HW1   Tutorial 2   HW2   Tutorial 3   HW3   Tutorial 4   HW4
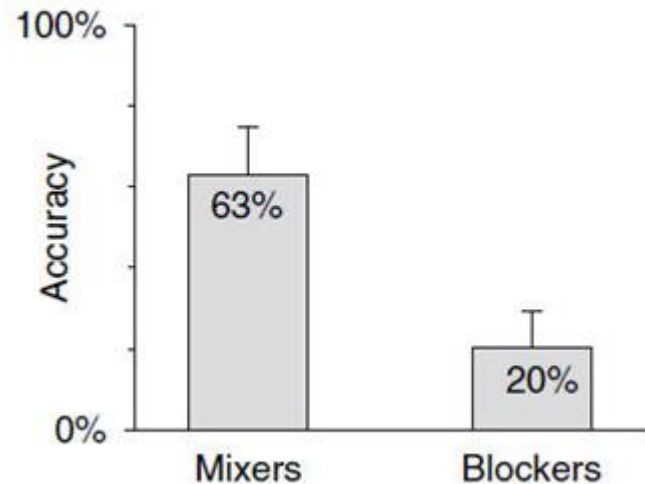
INTERLEAVERS (Mixers)

Tutorials 1, 2, 3, 4

HWs 1,2,3,4 mixed

Interleaved Practice

Reflection Exercise

What would you do for students so that they get practice testing, distributed practice and interleaved practice?
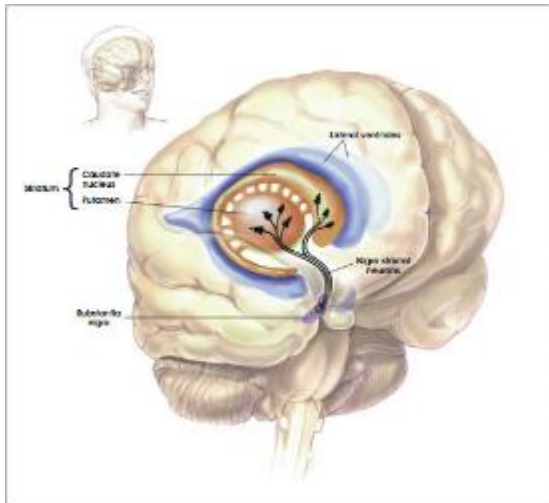
What is the Biggest Hindrance to Learning?

Multitasking

The Two Circuits in Brain

Circuit 1: This one is for reactive attention

Circuit 2: This one sets our mind to concentrate on something

Hippocampus
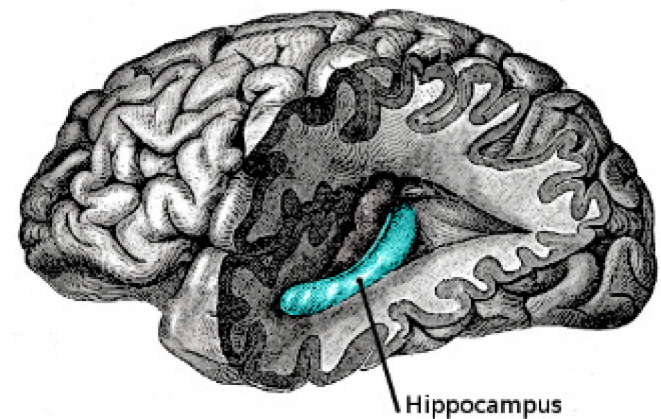
Negative Consequences of Multitasking While Doing College Work

- **More time spent**
- **Mental fatigue**
- **Memory failure**
- **Higher order learning suffers**

Source: The New Marshmallow Test: Students Can't Resist Multitasking, Annie Paul, slate.com; blog.reyjunco.com/

Reflection Exercise

What do you do in your classroom to discourage multitasking?

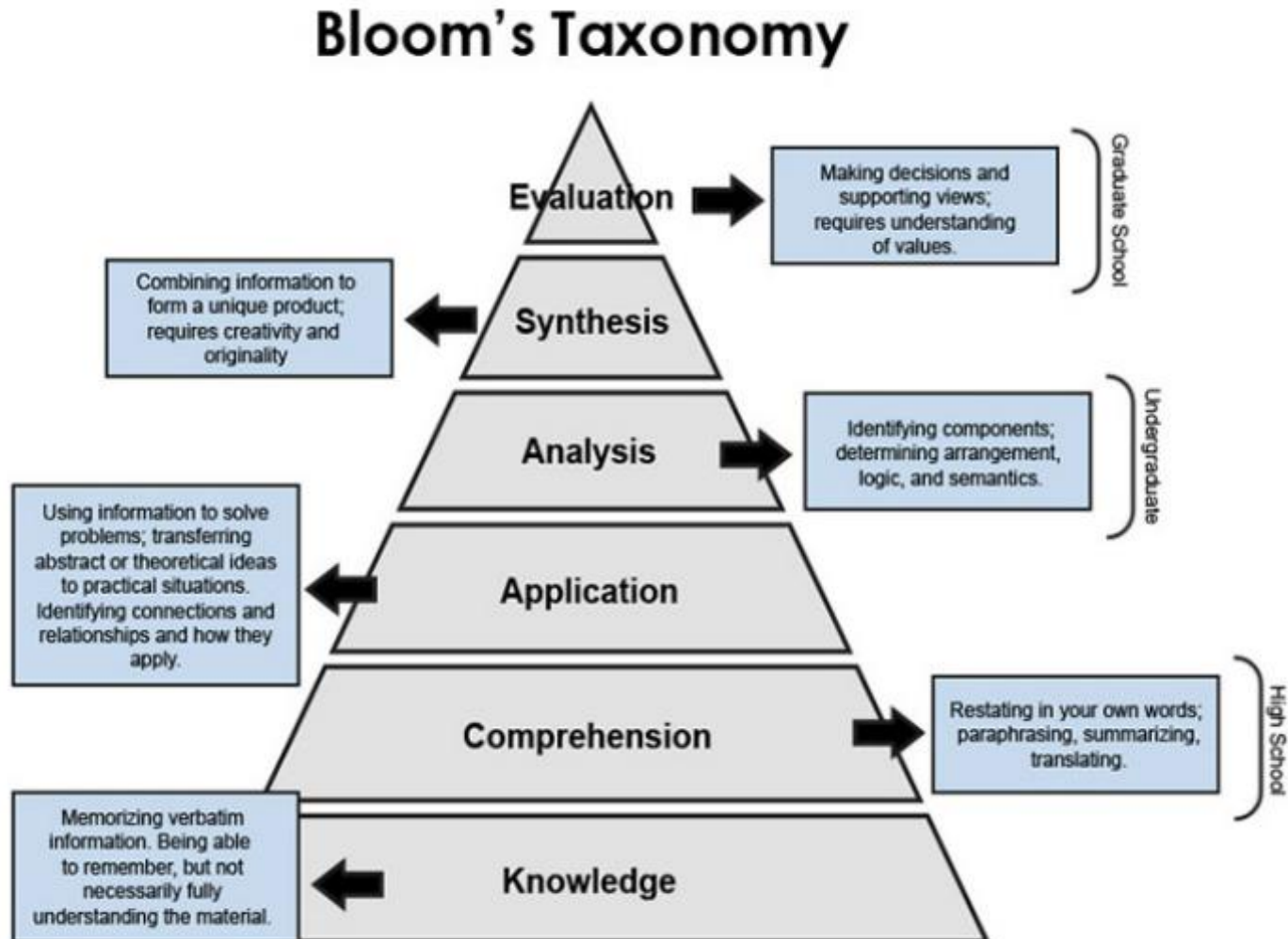# A Taxonomy to Follow to Learn

Typical Homework Assignment

Chapter 8 Assignments

Readings	Practice Problems
Section 8.4	pp. 397, 3-29 (odd), 33-67 (odd)
Section 8.7	pp. 425, 1-37 (odd), 53, 55
Section 8.8	pp. 432, 1-35 (odd)
Section 8.9	pp. 444, 1-35 (odd)
Section 8.6	pp. 416, 1-67 (odd)
	Chapter 8 Review

What is Bloom's Taxonomy?

Bloom's Taxonomy

Six Levels of Bloom's Taxonomy

- **Knowledge**: (repeating verbatim)
  - List, State
  - Example: How many laws of motion do we have?

- **Comprehension**: (demonstrate understanding)
  - Explain, Interpret
  - Explain the law of inertia using the example of a roller coaster.

- **Application**: (applying learned info to solve problem)
  - Calculate, Solve
  - Find the velocity of a rocket that starts from rest.....

Six Levels of Bloom's Taxonomy

- **Analysis**: (breaking things down, formulating mathematical models)
  - Derive, Explain
  - Derive the equation for velocity of a rocket using laws of motion

- **Synthesis**: (creating something, combining elements)
  - Formulate, Makeup, Design
  - Design a roller coaster

- **Evaluation**: (making and justifying judgments, selection from alternatives)
  - Determine, Select, Critique
  - Justify your selection from the following roller coaster designs

Reflection Exercise

Design six problems based on the six levels of Bloom's taxonomy.

Universal Design Learning

Universal Design Learning (UDL)
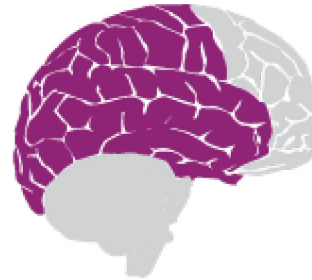

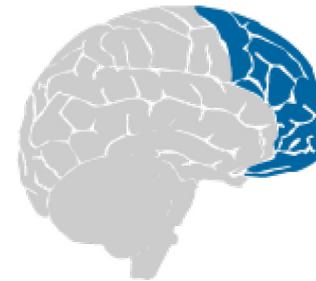Universal Design
for Learning
=
Learning
Opportunities
for All

for All.

The Trinity of UDL
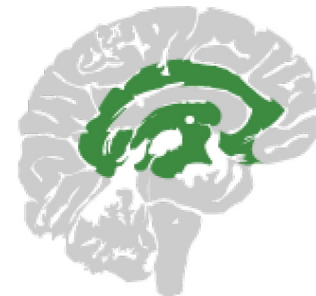
- **Multiple means of representation**

- **Multiple means of action and expression**

- **Multiple means of engagement**

What – Recognition network

How – Strategic Network

Why – Affective Network

National Center on Universal Design for Learning

Reflection Exercise

What do you do or will do to apply the three principles of Universal Design Learning?

Books Worth Reading

How Learning Works

Creating Significant Learning Experiences

Make it Stick

Mind for Numbers

Brain Rules

Teaching Naked

Knowing What Students Know

Universal Design for Learning: Theory and Practice

How People Learn

Flipped Learning

IMPROVING STUDENT SUCCESS IN AN ENGINEERING COURSE

QUESTIONS

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