Scholarly and evidence-based teaching: The risks and rewards

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CENTRE FOR TEACHING AND LEARNING

Abstract

In this session, Associate Director Neil Haave will discuss the benefits of considering the pedagogical literature when designing our learning environments. We will also consider how to respond when our best efforts are resisted by students.

Where are you from?

A. Alberta
B. Canada
C. North America
D. Rest of the world

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Use code: **OJU**

What are you teaching?

A. Sciences
B. Arts
C. Professional
D. Other

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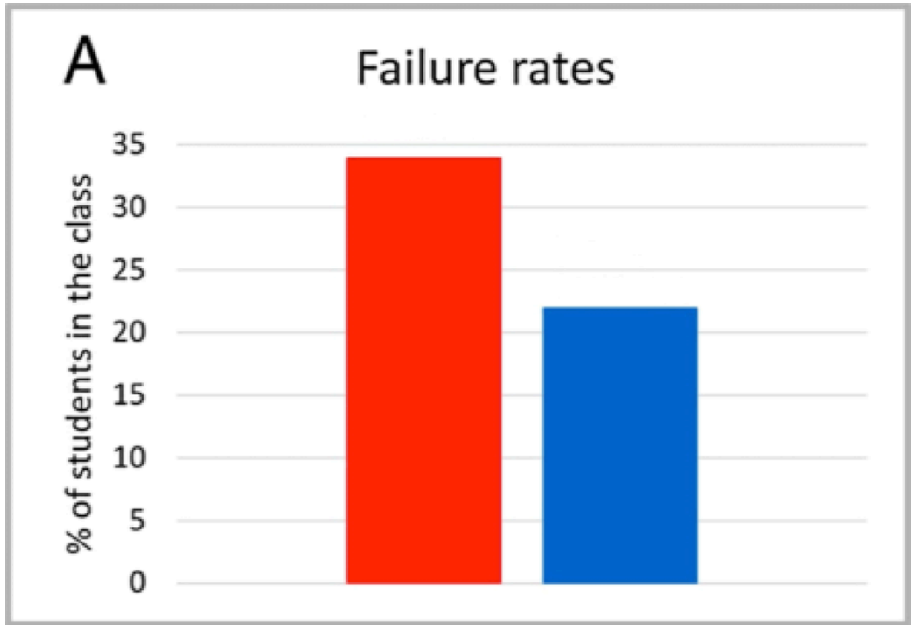
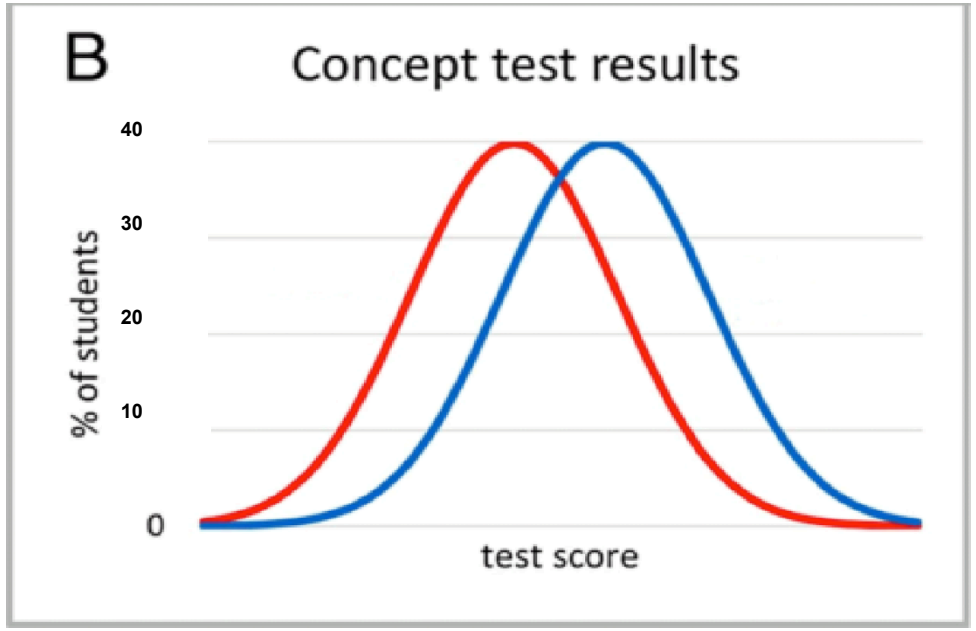
Evidence-based teaching

Which class would you rather be in: red or blue?





A – red classes
B – blue classes

C – panel A red class, panel B blue class
D – panel A blue class, panel B red class

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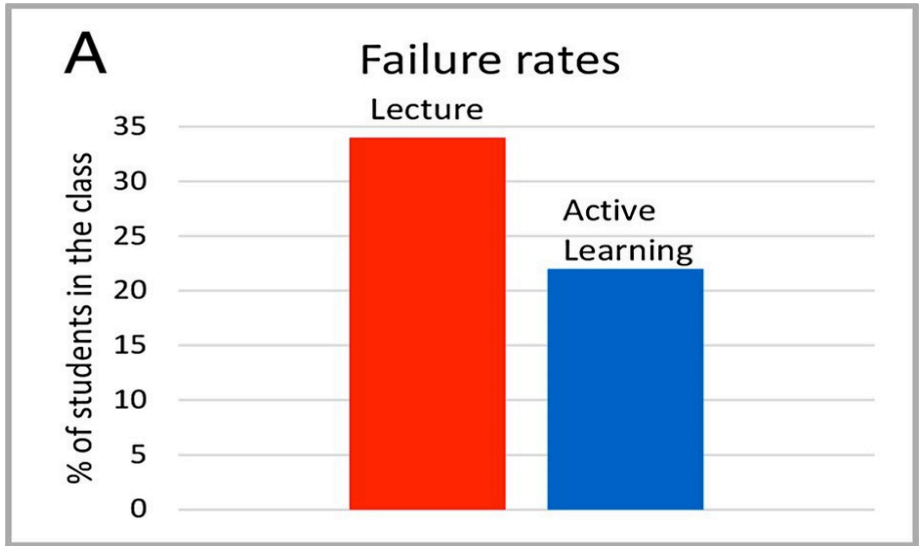
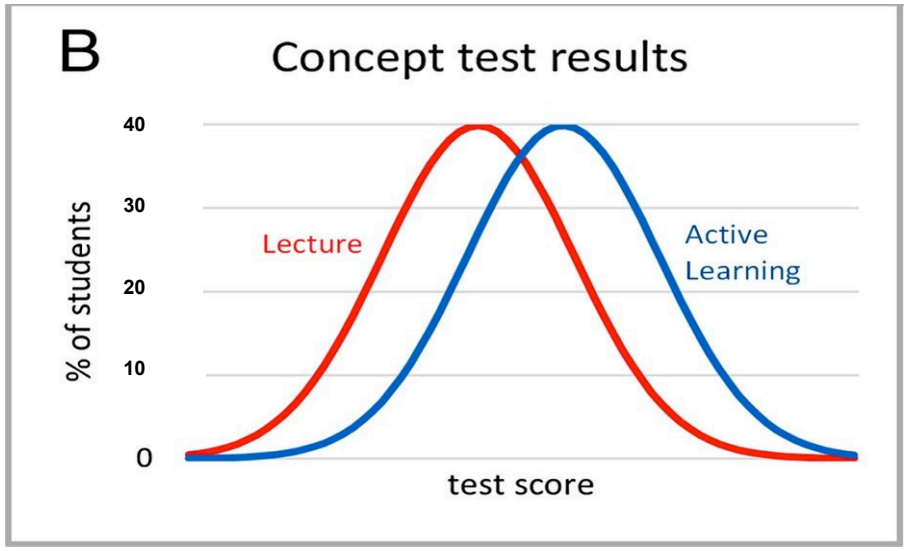
Evidence-based teaching: impact of active learning





If the experiments analyzed here had been conducted as randomized controlled trials of medical interventions, they may have been stopped for benefit—meaning that enrolling patients in the control condition might be discontinued because the treatment being tested was clearly more beneficial.

~ Freeman et al. 2014.

Wieman, Carl. E. (2014). Large-scale comparison of science teaching methods sends clear message. *Proceedings of the National Academy of Sciences of the United States of America*, 111(23), 8319–20.

So, why don't more instructors implement active learning strategies?

SEPTEMBER 10TH, 2014

"She Didn't Teach. We Had to Learn it Ourselves."

By: Maryellen Weimer, PhD

THE Teaching PROFESSOR BLOG

The Teaching Professor April 2004

'The Professor Made Us Do It Ourselves'

By Larry Spence, College of Information Technology, Penn State
lspence@ist.psu.edu

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Journal of the Scholarship of Teaching and Learning, Vol. 11, No. 1, January 2011, pp. 53 – 61.

Is active learning like broccoli? Student perceptions of active learning in large lecture classes

C. Veronica Smith[1] and LeeAnn Cardaciotto[2]

Abstract: Although research suggests that active learning is associated with positive outcomes (e.g., memory, test performance), use of such techniques can be difficult to implement in large lecture-based classes. In the current study, 1,091 students completed out-of-class group exercises to complement course material in an Introductory Psychology class. Students were assigned either active learning or content review activities. Students in the active learning condition reported greater retention of and engagement with the course material but not greater enjoyment when compared to students in the content review condition. The importance of choosing pedagogical methods that promote the construction of knowledge rather than just behavioral activity is discussed.

Journal of the Scholarship of Teaching and Learning, Vol. 16, No. 2, April 2016, pp. 29-38.
doi: 10.14434/josotl.v16i2.19216

Discrepancies between student perception and achievement of learning outcomes in a flipped classroom

Jenna Van Sickle[1]

Abstract: In a college algebra course that used flipped/inverted pedagogy, students achieved learning outcomes at a significantly higher rate, as evidenced by results on the final exam. At the same time, student perception on a number of measures decreased significantly, including how interested students were in the course and whether the instructor effectively facilitated learning. This article will draw on a variety of research to suggest reasons for these discrepancies and possible solutions to help improve student perception in learner-centered instruction.

Why the student misperception?

- *Engaging in the hard, messy work of learning*
- First experience with learner-centered instruction
  - incongruent with student learning culture
- Lack of preparation outside class
  - in-class faced with what students do not know which may make them feel like they are learning less in class
- Student-student & student-teacher relationships
  - traditional is more equitable
  - learner-centered relies more on peer learning
- Class culture: is it okay to be wrong?

Van Sickle, J. R. (2016). Discrepancies between student perception and achievement of learning outcomes in a flipped classroom. *Journal of the Scholarship of Teaching and Learning*, *16*(2), 29–38.
Weimer, M. (2013). *Learner-centered teaching: Five key changes to practice* (2nd ed.). San Francisco, CA: Jossey-Bass, a Wiley imprint.
McCollum, B. M., Fleming, C. L., Plotnikoff, K. M., & Skagen, D. N. (2017). Relationships in the flipped classroom. *Canadian Journal for the Scholarship of Teaching and Learning*, *8*(3), 1–21.

What things can be done to alleviate student resistance?

- Explain reasons at the beginning ***& during*** the course
  - Share the data/studies/literature
- ***Facilitate*** the activity
  - Walk around among the students, ask questions, use student names
- Link the teaching strategies with ***post-college life***
  - Ask students which skills they think they may need
- ***Give students a voice*** in expressing concern over you and their peers
  - Mid-course feedback for both the instructor and their team-mates
- Scaffold independent learning
  - This is tricky: it is critically ***situational & context dependent***

How are these implemented in a particular class context?

Felder, R. M., & Brent, R. (1996). Navigating the bumpy road to student-centered instruction. *College Teaching*, *44*(2), 43–47.
Finelli, B. C. J., et al. (2018). Reducing student resistance to active learning: Strategies for instructors. *Journal of College Science Teaching, 47*(5), 80–91.
Seidel, S. B., & Tanner, K. D. (2013). "What if students revolt?"—Considering student resistance: Origins, options, and opportunities for investigation. *CBE-Life Sciences Education*, *12*(4), 586–595.
Weimer, M. (2013). Responding to resistance. In *Learner-centered teaching: Five key changes to practice* (2nd ed., pp. 199–217). San Francisco, CA: Jossey-Bass, a Wiley imprint.

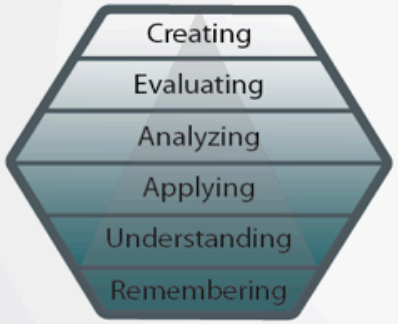
Blooms Taxonomy

Language for communicating about learning

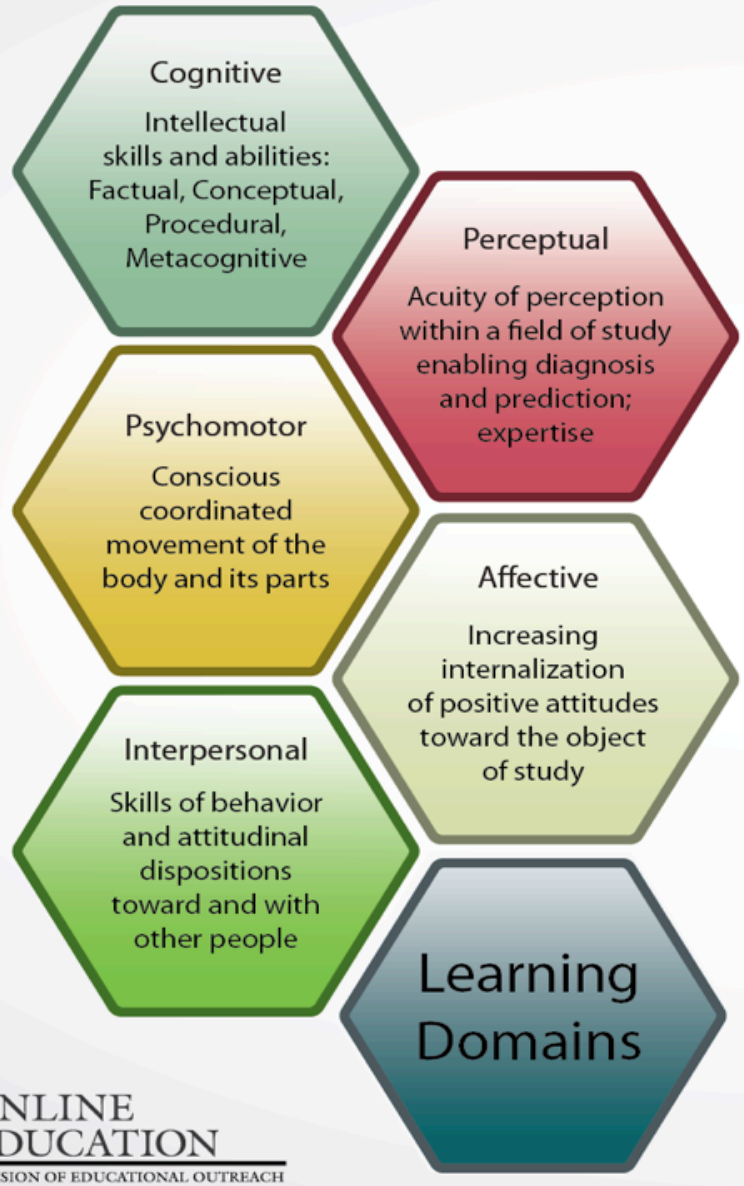
Learning Levels

Levels describe the extent of learning, ranging from:

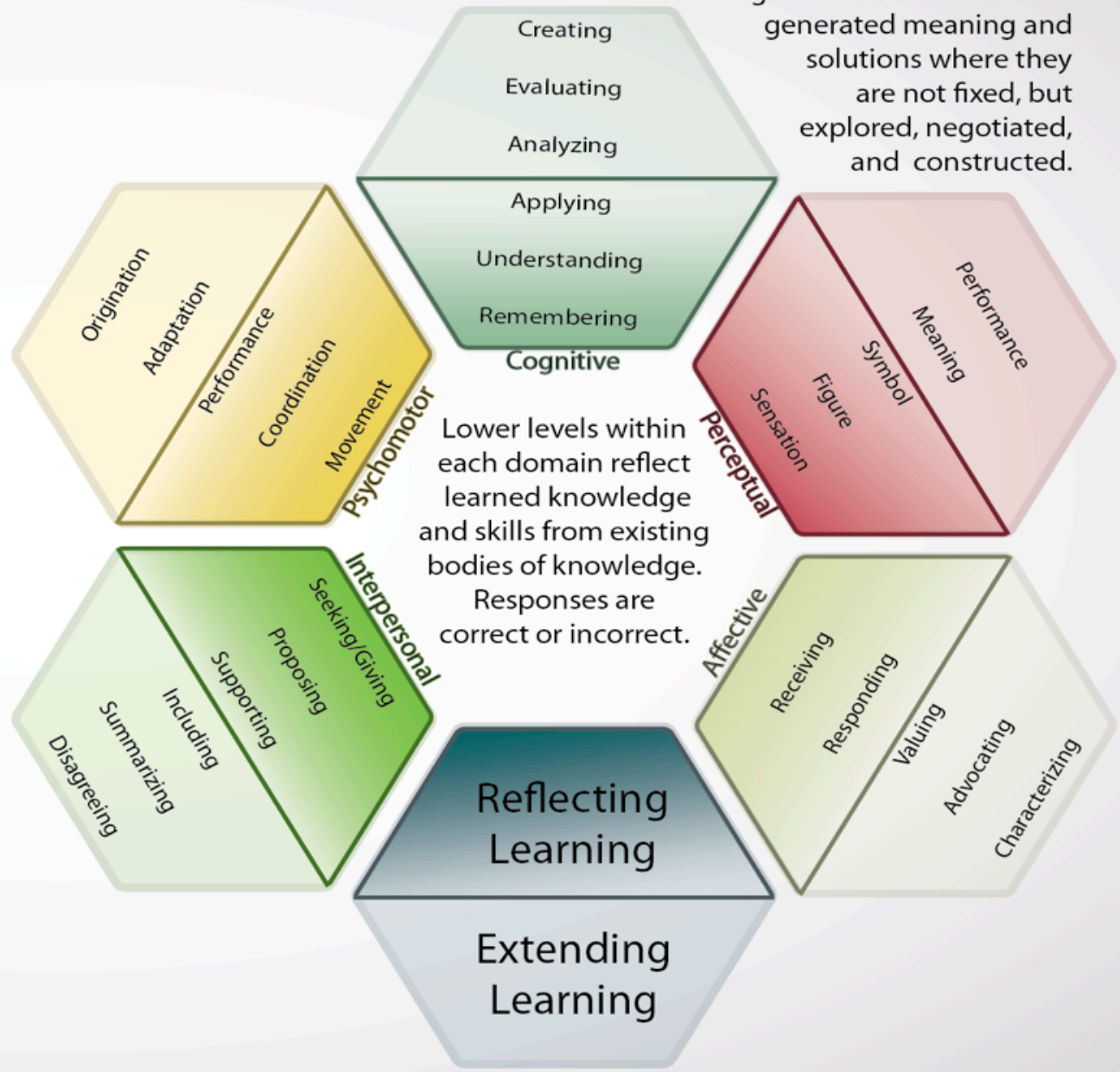
- simple to complex
- superficial to deep
- isolated to integrated



Hierarchy conveys the need for learners to master lower levels before progressing to higher levels.



Higher levels reflect learner generated meaning and solutions where they are not fixed, but explored, negotiated, and constructed.



Lower levels within each domain reflect learned knowledge and skills from existing bodies of knowledge. Responses are correct or incorrect.

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Kevin Wilcoxon, Instructional Designer at University of Nevada Las Vegas. https://elearningindustry.com/the-60-second-guide-to-blooms-taxonomy

Top 10 employee skills employers desire

- Leadership 80.1%
- Ability to work in a team 78.9%
- Communication skills (written) 70.2%
- Problem-solving skills 70.2%
- Communication skills (verbal) 68.9%
- Strong work ethic 68.9%
- Initiative 65.8%
- Analytical/quantitative skills 62.7%
- Flexibility/adaptability 60.9%

NACE. 2015. *Job Outlook 2016*. Bethlehem (PA): National Association of Colleges and Employers.

Which of the following would be better achieved through individual study?

A. Acquiring information (facts, principles, concepts)
B. Learning how to use information and knowledge in new situations
C. Developing life-long learning skills

Smith, G. A. (2008). First-day questions for the learner-centered classroom. *The National Teaching & Learning Forum*, *17*(5), 1–4.

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All three goals are clearly important; for instance you can't use knowledge without first obtaining it. But, let's think for a moment of how best to accomplish these goals. Learning is not a spectator sport – it takes work; that includes work in the classroom and work that you do outside of the classroom. Which of the items below would be better achieved in class?

A. Acquiring information (facts, principles, concepts)
B. Learning how to use information and knowledge in new situations
C. Developing life-long learning skills

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Use code: **OJU**

Smith, G. A. (2008). First-day questions for the learner-centered classroom. *The National Teaching & Learning Forum*, *17*(5), 1–4.

Thinking of what you want to get out of your university education and this course, which of the following is most important to you?

A. Acquiring information (facts, principles, concepts)
B. Learning how to use information and knowledge in new situations
C. Developing lifelong learning skills

Smith, G. A. (2008). First-day questions for the learner-centered classroom. *The National Teaching & Learning Forum*, *17*(5), 1–4.

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1st-yr reading guide for photosynthesis

CTL Teaching Institute 2019

UNIVERSITY OF ALBERTA
CENTRE FOR TEACHING AND LEARNING

AUBIO 111 - Integrative Biology I
Dr. Neil Haave
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780 679 1506

Department of Science
University of Alberta
Augustana Campus

Reading Guide IV
How do photoautotrophs make their own food?

Reece JB, Urry LA, Cain ML, Wasserman, SA, Minorsky PV, Jackson RB, Rawle F, Durnford D, Moyes C, Scott K, Walde S. 2018. CAMPBELL BIOLOGY, 2nd Canadian ed. Toronto (ON): Pearson Education. Chapter 10.

Objectives & keywords

1. Describe the location and structure of the chloroplast and how this structure relates to its function. (198-201, fig 10.4)

   stroma granum thylakoid space chlorophyll thylakoid membrane thylakoid

2. Write a summary equation for photosynthesis. (201, fig 10.5)

3. Explain the role of redox reactions in photosynthesis. (201-202)

4. Describe the steps in the light reactions, where they occur and summarize them with an equation. (*Don't worry about the details of the complexes in the electron transport chain or P680 and P700*) (202-203, 208-209, figs 10.6, 10.13, 10.14 & 10.15)

   photosystem II (PS II) photosystem I (PS I) cytochrome *b/f* linear electron flow

5. Distinguish cyclic electron flow from non-cyclic electron flow. (209-210, fig 10.16)

6. Describe important differences in chemiosmosis between oxidative phosphorylation in mitochondria, photophosphorylation in chloroplasts, and substrate-level phosphorylation in glycolysis and the citric acid cycle. (210-212, figs 9.7, 10.17 & 10.18)

7. Summarize the carbon-fixing reactions of the Calvin cycle. (*Don't worry about any intermediates not listed in the keywords or the specific numbers of ATP and NADPH. Memorizing biochemical structures is not necessary)* (212-213, fig 10.19)

   glyceraldehyde-3-phosphate (G3P) 3-phosphoglycerate reduction Rubiso
   ribulose-bisphosphate (RuBP) carbon fixation regeneration

8. Describe the role of ATP and NADPH in the Calvin cycle. (212-213)

9. Explain the significance of photosynthesis. (217-218, fig 10.22)

Retrieval practice

Figure Questions: *10: 12, 16, 19, 22*
Concept Checks: *10: 1-3*
Test Your Understanding: *10: 1-2, 4-7,10*

Created: 2015 July
Last updated: *2017 August 7*

2nd-yr note outline for the TCA cycle

B/C 280 – Biochemistry: Proteins, Enzymes & Energy
NC Haave, PhD
Augustana Faculty
University of Alberta

Tricarboxylic Acid (TCA) Cycle – topic outline

I. Mitochondrion structure

II. Stages of cellular respiration
   A. Glycolysis
   B. Pyruvate oxidation
   C. TCA cycle
   D. Oxidative phosphorylation

III. Acetyl CoA as substrate for the TCA cycle
   A. Sources of acetyl CoA
   B. Pyruvate oxidation
      1. Transport across the MIM
      2. Pyruvate DH
         a. Three enzymes – a multienzyme complex
         b. Five coenzymes
         c. Five reactions
         d. Mammalian enzyme includes regulatory kinases and phosphatases

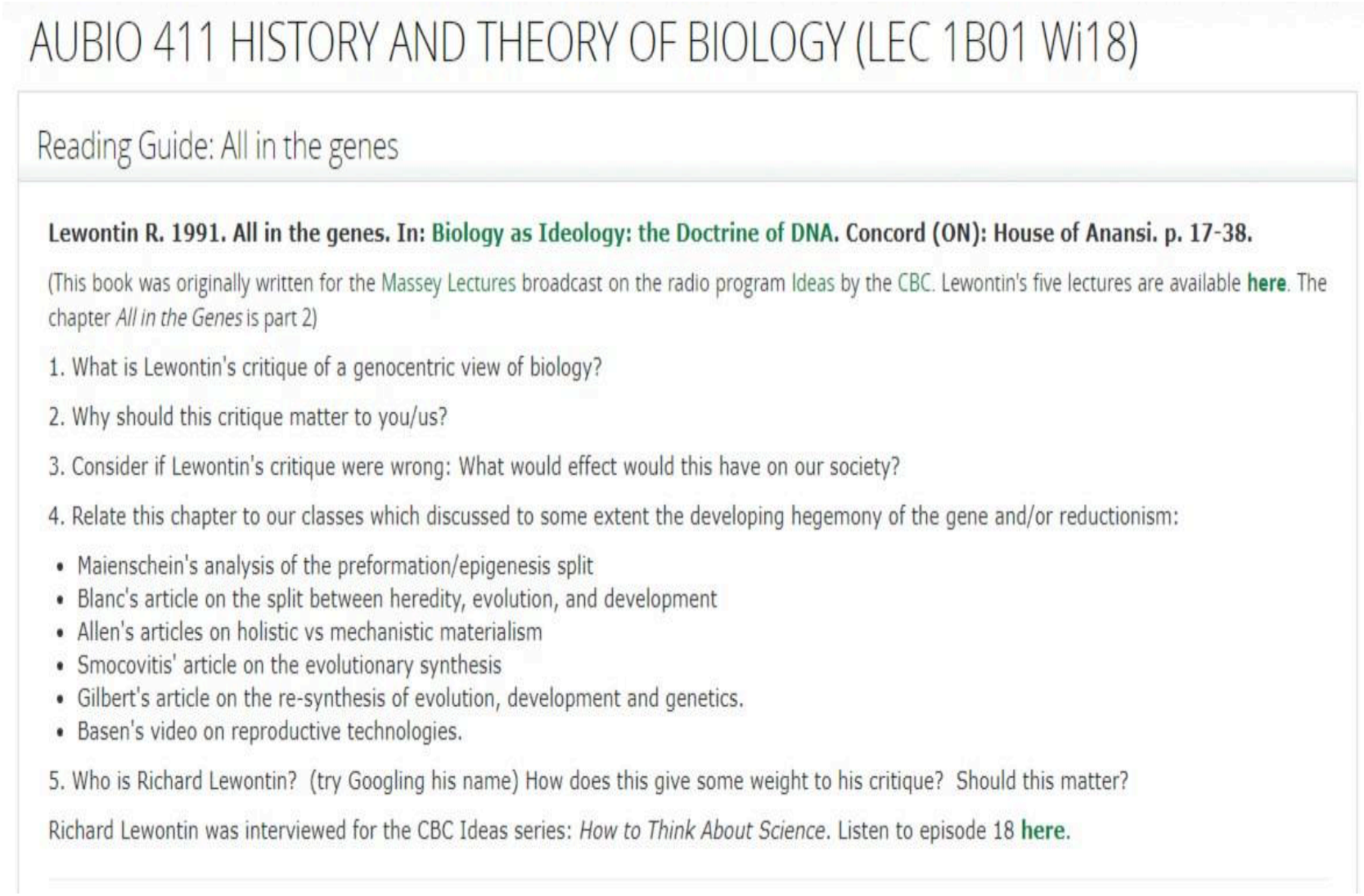
IV. TCA cycle (aka Krebs cycle or citric acid cycle)
   A. Two phases - Eight enzymes: *be able to explain the biochemical logic*
      1. Oxidation phase
         a. citrate synthase – condensation
         b. aconitase - rearrangement
         c. isocitrate DH – oxidative decarboxylation
         d. α-ketoglutarate DH – oxidative decarboxylation
      2. regeneration phase
         a. succinyl CoA synthetase – substrate-level phosphorylation
         b. succinate DH – dehydrogenation (an oxidation; a transmembrane protein)
         c. fumarase – hydration
         d. malate DH – dehydrogenation (an oxidation)
   B. Fates of the carbon and oxygen atoms (radiolabel experiments)
      1. *When are the carbons of acetyl CoA lost as CO_2?*
      2. *Why cannot acetyl CoA be used to make carbohydrate?*
   C. Regulation
      1. Pyruvate DH
      2. Isocitrate DH
      3. α-ketoglutarate DH
      4. energy status: availability of….
         a. NAD^+ *(which enzymes affected?)*
         b. CoQ *(which enzymes affected?)*
         c. GDP (i.e. ADP; *which enzymes affected?)*
   D. Amphibolic nature
   E. Anaplerotic reactions (e.g. pyruvate carboxylase)

V. The glyoxylate cycle
   A. Function *(found in which organisms?)*
   B. Two enzymes bypass oxidative decarboxylations of TCA cycle
   C. Three compartments
   D. Four pathways convert fat to CH_2O

How support students' transition to independent learning?

4th yr example

Instead of a reading quiz, students are held responsible for their pre-class reading via a typed 2-page response to the reading which acts as their ticket to class.



AUBIO 411 HISTORY AND THEORY OF BIOLOGY (LEC 1B01 Wi18)

Reading Guide: All in the genes

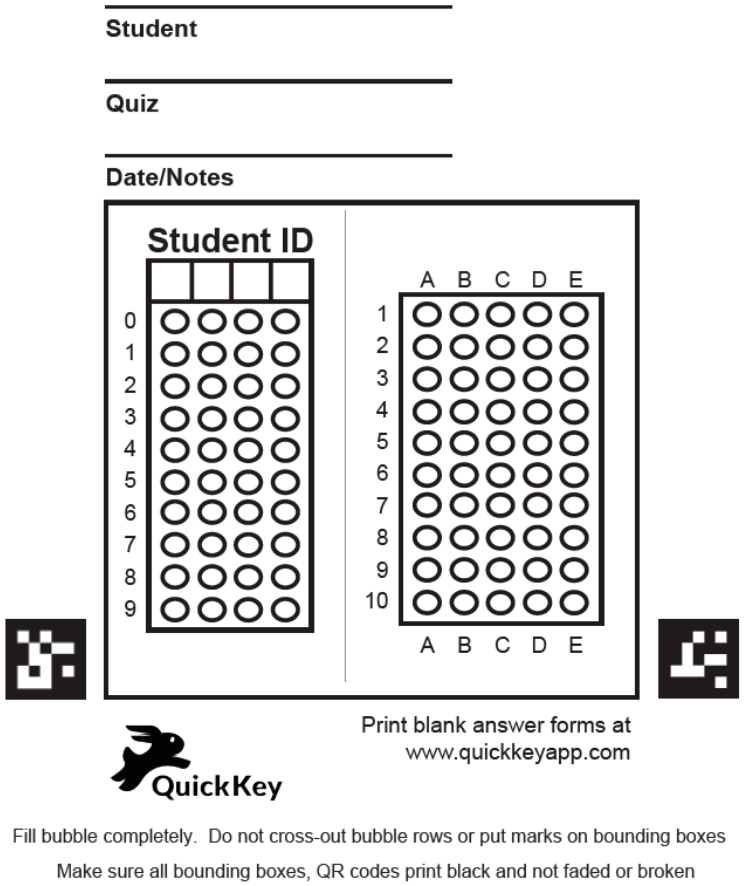
Lewontin R. 1991. All in the genes. In: Biology as Ideology: the Doctrine of DNA. Concord (ON): House of Anansi. p. 17-38.

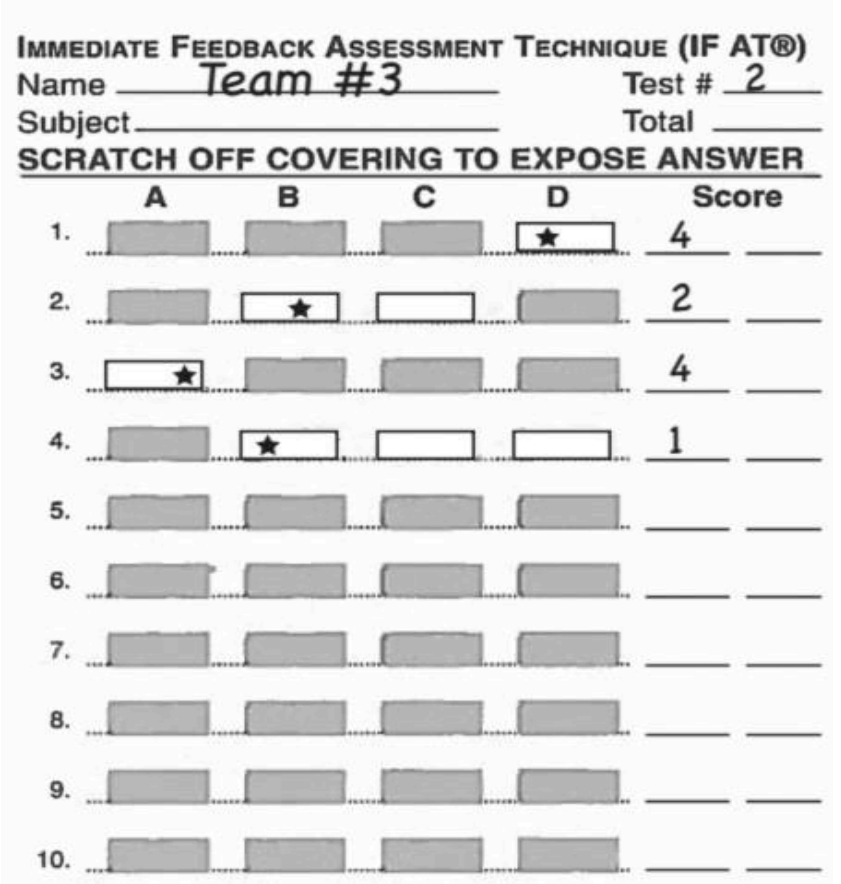
(This book was originally written for the Massey Lectures broadcast on the radio program Ideas by the CBC. Lewontin's five lectures are available **here**. The chapter *All in the Genes* is part 2)

1. What is Lewontin's critique of a genocentric view of biology?
2. Why should this critique matter to you/us?
3. Consider if Lewontin's critique were wrong: What would effect would this have on our society?
4. Relate this chapter to our classes which discussed to some extent the developing hegemony of the gene and/or reductionism:
   - Maienschein's analysis of the preformation/epigenesis split
   - Blanc's article on the split between heredity, evolution, and development
   - Allen's articles on holistic vs mechanistic materialism
   - Smocovitis' article on the evolutionary synthesis
   - Gilbert's article on the re-synthesis of evolution, development and genetics.
   - Basen's video on reproductive technologies.
5. Who is Richard Lewontin? (try Googling his name) How does this give some weight to his critique? Should this matter?

Richard Lewontin was interviewed for the CBC Ideas series: *How to Think About Science*. Listen to episode 18 **here**.

Quick Key & IF AT cards for reading quizzes: An example of two-stage testing



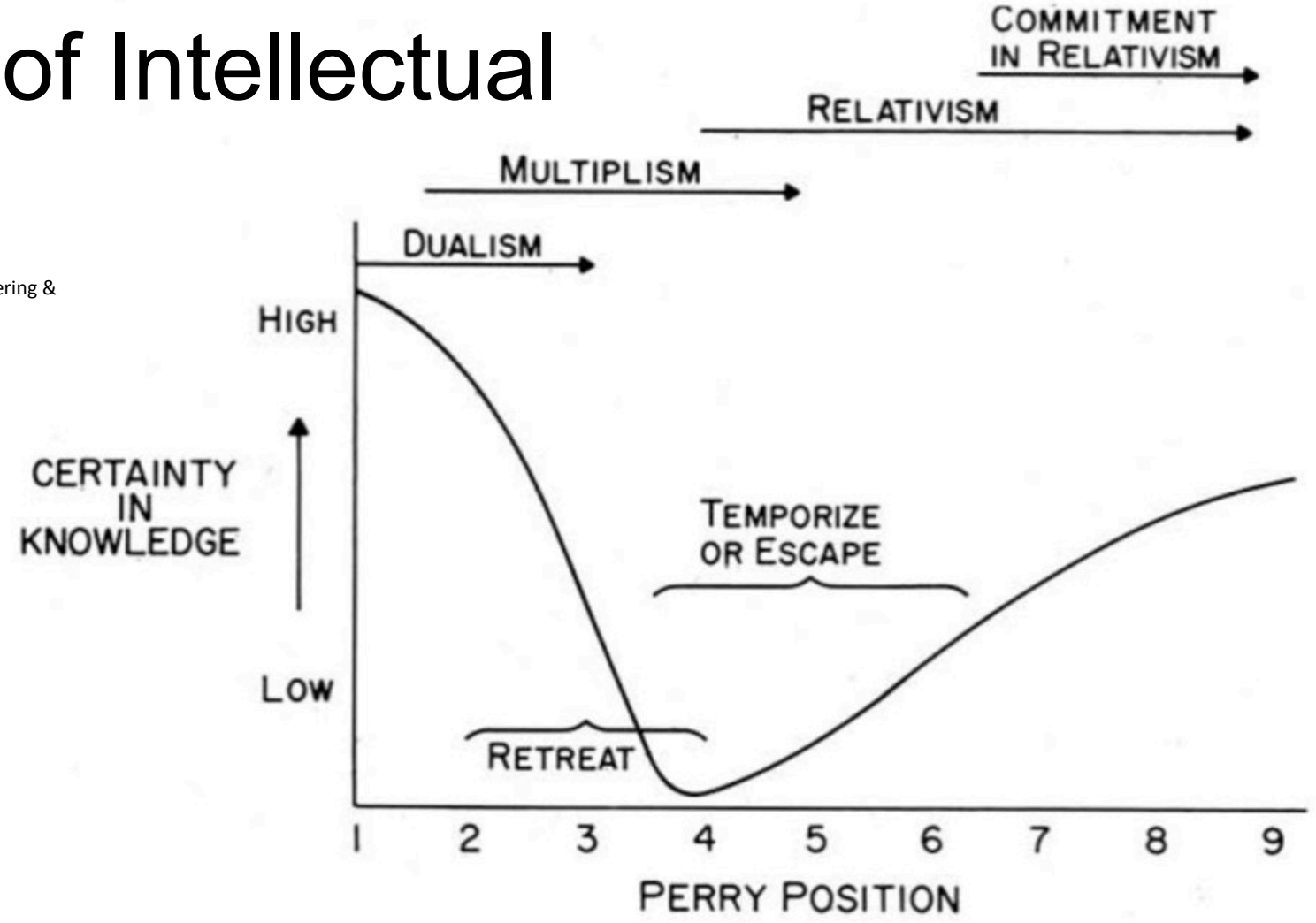


https://get.quickkeyapp.com/

http://www.epsteineducation.com/home/

The Perry Scheme of Intellectual Development

Perry, William G. (1981). Cognitive and ethical growth: The making of meaning. In A. W. Chickering & Associates (Eds.), *The Modern American College* (pp. 76–116). San Francisco, CA: Jossey-Bass.



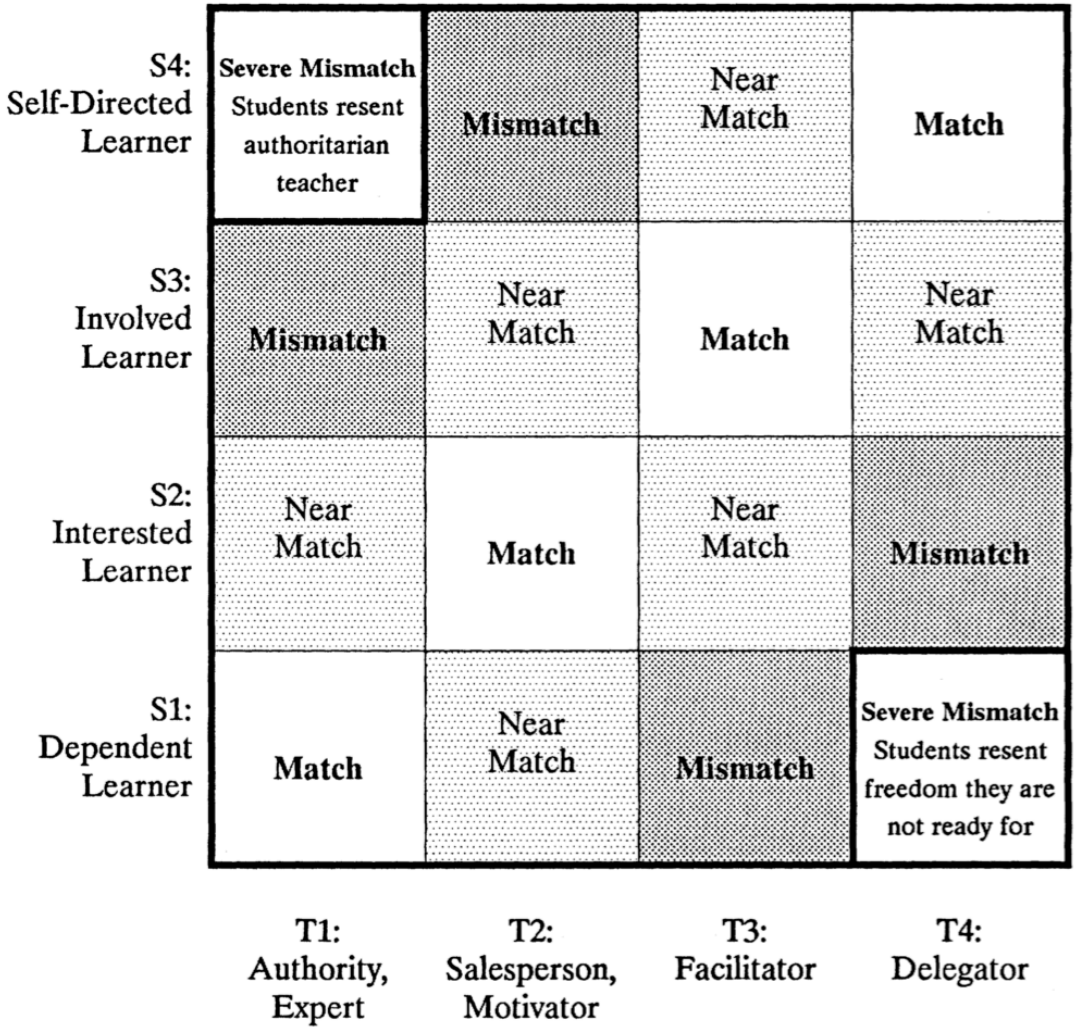
Finster, David C. (1989). Developmental instruction: Part I. Perry's model of intellectual development. *Journal of Chemical Education*, *66*(8), 659-661.

The art of teaching

- instructor experience
- learner maturity

- Zone of proximal development

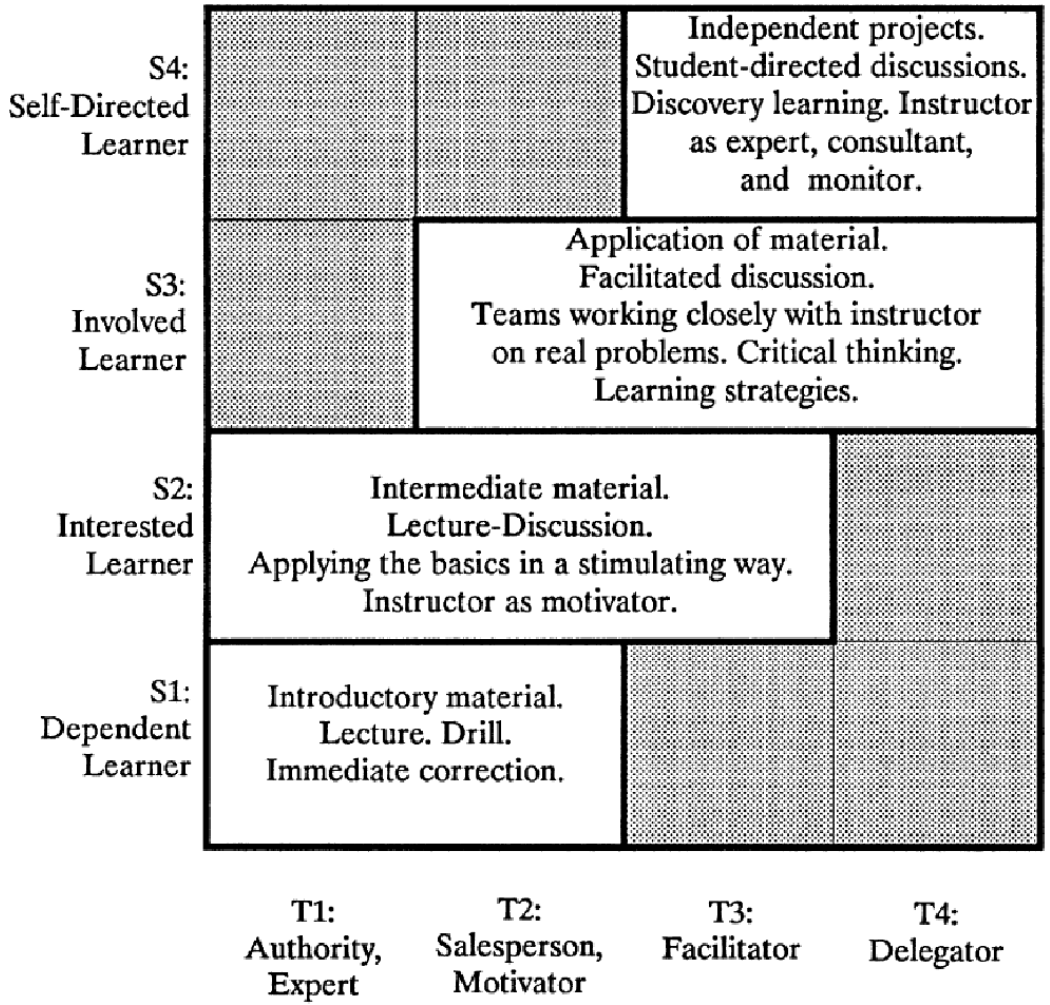
(Lev Vygotsky, 1896-1934)



Grow, Gerald. O. (1991). Teaching learners to be self-directed. *Adult Education Quarterly*, *41*(3), 125–149.

Staged self-directed learning

- Scaffold opportunities to practice independent learning
    - Across the curriculum
    - Across the term
    - Within a learning module
    - Within a class



Grow, Gerald. O. (1991). Teaching learners to be self-directed. *Adult Education Quarterly*, *41*(3), 125–149.

What can teachers do?

Learning results from what the student does and thinks and only from what the student does and thinks. The teacher can advance learning only by influencing what the student does to learn.

~ Herbert A. Simon

(1916 –2001)
Nobel Laureate
Co-founder of Cognitive Science
Professor, Carnegie Mellon University

Ambrose, S. A., Bridges, M. W., DiPietro, M., Lovett, M. C., & Norman, M. K. (2010). Introduction: Bridging learning research and teaching practice. In *How learning works: Seven research-based principles for smart teaching* (pp. 1–9). San Francisco, CA: Jossey-Bass, a Wiley imprint.

SoTL Scholars Program

- A new program through CTL
- Designed to develop SoTL capacity at the UofA
- Improve our teaching to enable student learning by
  - critically reflecting on our own teaching
  - Assessing our own teaching
- Moving faculty from consumers of SoTL to SoTL scholars

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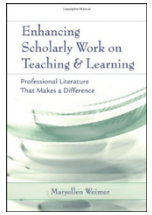
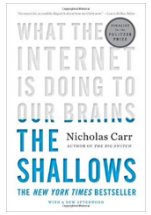
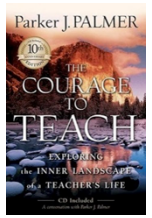
Books that have impacted my understanding of learning…1



Weimer, M. (2006). *Enhancing Scholarly Work on Teaching and Learning: Professional Literature that Makes a Difference*. San Francisco, CA: Jossey-Bass.

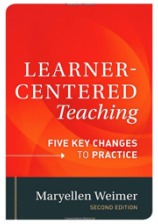


Carr, N. (2010). *The Shallows: What the Internet Is Doing to Our Brains*. New York, NY: W. W. Norton.



Palmer, P. J. (2007). *The Courage to Teach: Exploring the Inner Landscape of a Teacher's Life* (10th anniv.). San Francisco, CA: John Wiley and Sons.

Books that have impacted my understanding of learning…2



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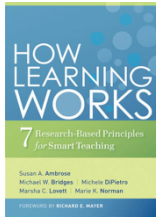
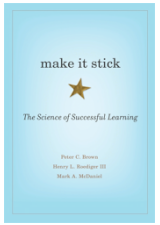


Ambrose, S. A., Bridges, M. W., DiPietro, M., Lovett, M. C., & Norman, M. K. (2010). *How Learning Works: Seven Research-Based Principles for Smart Teaching*. San Francisco, CA: John Wiley & Sons, Inc.



Brown, P. C., Roediger III, H. L., & McDaniel, M. A. (2014). *Make it Stick: The Science of Successful Learning* (pp. 200–253). Cambridge, MA: The Belknap Press of Harvard University Press.