Our Classrooms as Ecological Systems

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Resources related to the talk given January 6, 2016 in the 2016 JMM Panel –
Developing the MAA Pedagogy Guide
Materials available at http://myweb.lmu.edu/jdewar/ecology

Bibliography and Resources:

About Haeckel and the Original Definition of Ecology

Egerton, F. N. (2013). History of Ecological Sciences, Part 47: Ernst Haeckel's Ecology. *Bulletin of the Ecological Society of America, 94*(3), 222-244. Available at
http://esapubs.org/bulletin/current/history_list/history47.pdf

About the Promising Syllabus

A brief synopsis:
The "promising syllabus" tells what kind of learning the course promises the students. In addition to the standard information about the professor (name, contact information, etc.) the syllabus presented as promises would contain three elements:
1. What this Course Promises You (Tells students what they will have the opportunity to learn and how it will help or affect their future -- essentially the learning outcomes, but told as a promise, preferably as part of a story).
2. Ways to Fulfill Those Promises (formerly known as requirements and assignments)
3. Ways for the student and teacher to know whether the student is achieving the promises (formerly known as "Grading Policy.")

Online resource:
- Montclair State University, Research Academy for University Learning explains what Ken Bain meant by this term in his book, *What the Best College Teachers Do,* published by Harvard University in 2004, and tells how to write one.
  http://www.montclair.edu/academy/resources/teaching-resources/the-promising-syllabus/

About Course Design

A brief synopsis:
The best way to build a course is backwards (Fink, 2013; Wiggins & McTighe, 1998).
1. Begin by articulating the goals you have for students at the end of the course (and give some thought to what you want them to remember "long-term")
2. Next figure out what evidence would tell you how well they achieved the goals
3. Then choose the activities/experiences that would enable them to achieve those goals

Recommended books:

Fink, L. D. (2013). *Creating Significant Learning Experiences: An Integrated Approach to Designing College Courses* (Revised and Updated). San Francisco, CA: Jossey-Bass.

Wiggins, G. & McTighe, J. (2005). *Understanding by Design* (Expanded 2nd Ed.). Alexandria, VA: Association for Supervision and Curriculum Development.

Online resources that draw on Wiggins & McTighe (1998):
- Vanderbilt University Center for Teaching Course Design Guide
  http://cft.vanderbilt.edu/guides-sub-pages/course-design/
- Carleton College Science Education Research Center hosts the Cutting Edge course design tutorial (funded by NSF grant DUE-0127310)
  http://serc.carleton.edu/NAGTWorkshops/coursedesign/tutorial/index.html

Online resources that draw on Fink (2003, 2013):
- Illinois State University Center for Teaching, Learning and Technology
  http://ctlt.illinoisstate.edu/pedagogy/modules/design/
- A Self-Directed Guide to Designing Courses for Significant Learning
  http://www.deefinkandassociates.com/GuidetoCourseDesignAug05.pdf

Recent articles about course design making a difference in science courses:
- "Getting Under the Hood: How and for Whom Does Increasing Course Structure Work?" by Sarah Eddy and Helly Hogan in the fall, 2014 issue of *CBE Life Sciences Education*. See http://www.lifescied.org/content/13/3/453.full.pdf
- "Colleges Reinvent Classes to Keep More Students in Science." See http://www.nytimes.com/2014/12/27/us/college-science-classes-failure-rates-soar-go-back-to-drawing-board.html?_r=0

How Learning/Memory Work in the Brain

A brief synopsis:
Learning, that is, making new memories, involves making changes in the physical structure of the brain. Inside the brain are nerve cells called neurons. When you think (see/hear/sense), they fire, sending chemical signals to one another that create new connections. These connections can easily disappear unless you stabilize them by repeated attentive efforts/practice/use. The metaphor of exercising your brain to make it stronger is very apt, as is the idea of connecting new knowledge to old.

Recommended book:
Leamnson, R. *Thinking About Teaching and Learning: Developing Habits of Learning with First Year College and University Students.* Sterling, VA: Stylus Press. 1999.

Online resource:
Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.) (2000). *How People Learn: Brain, Mind, Experience, and School* (Expanded Edition). Washington, DC: National Academy Press. Available for free download at http://www.nap.edu/download.php?record_id=9853#

Novice vs. Expert Organization of Ideas

A brief synopsis:
Novices and experts have their knowledge organized in different ways (Ambrose et al., 2010). How a person organizes what they know about a subject affects what they notice and how they interpret information. This, in turn, affects their abilities to remember, reason, and solve problems. Our teaching will be more effective if we help our students with how they organize all the material that is presented in our course. Chapter 2 of *How Learning Works* (Ambrose et al., 2010) is a good resource on this topic. They suggest giving students an overall organizational structure for the course, presenting boundary or contrasting cases that highlight the organization of a topic/area, giving them sorting tasks, using concept maps, making connections explicit, etc.

Recommended book:
Ambrose, S. A., Bridges, M.W., DiPietro, M. & Lovett, M.C. (2010). *How learning works: Seven research-based principles for smart teaching.* San Francisco, CA: Jossey Bass.

Affective Domain of Learning

"Relative to instruction, the affective domain refers to the attitudes, beliefs, values and motivation of both students and faculty. Studies across many fields have demonstrated that positive attitudes, beliefs, values and motivation can promote improvements in learning" (Dewar, 2010).

A short overview article on the affective domain:
Dewar, J. (2010, Nov/Dec). The Affective Domain. *AWM Newsletter, 40*(6), 7-9. Available at http://www.drivehq.com/file/df.aspx/shareID8755087/fileID929334794/AWM News NovDec 2010.pdf

Online resource:
- Science Education Research Center at Carleton college hosts quite a bit of material on this topic developed for a 2007 Workshop on Student Motivations and Attitudes: The Role of the Affective Domain in Geoscience Learning
  http://serc.carleton.edu/NAGTWorkshops/affective/index.html

Classroom Climate

A brief synopsis:
Ambrose *et. al.* (2010) define classroom climate as "the intellectual, social, emotional, and physical environments in which our students learn. Climate is determined by a constellation of interacting factors that include faculty-student interaction, the tone instructors set, instances of stereotyping or tokenism, the course demographics (for example, relative size of racial and other social groups enrolled in the course), student-student interaction, and the range of perspectives represented in the course content and materials" (p.170).

Ambrose, S. A., Bridges, M.W., DiPietro, M. & Lovett, M.C. (2010). *How learning works: Seven research-based principles for smart teaching.* San Francisco, CA: Jossey-Bass.

Online resource:
- Cornell University's Center for Teaching Excellence:
http://www.cte.cornell.edu/teaching-ideas/building-inclusive-classrooms/classroom-climate.html

Stereotype threat

A brief synopsis:
Stereotype threat (ST) refers to a person's fear of confirming a negative stereotype about his or her social/racial/gender group. This anxiety can decrease performance on challenging tasks by depleting working memory. There are a number of things that instructors can do to reduce ST, all of which are "good teaching practice." One of these is to encourage students to adopt a "growth mindset" (see following section).

Online resources:
- An in-depth and well-documented treatment of stereotype threat, its mechanisms, consequences, how to address it, criticisms of it, and more is found at
http://www.reducingstereotypethreat.org/
- UCLA Center for the Study of Women lecture series on Women and STEM
A videotaped presentation titled "Stereotypes and the nurture of intelligent thought and behavior" by Joshua Aronson, one of the original researchers of stereotype threat, is available at http://www.csw.ucla.edu/publications/videocasts/women-and-stem

Recommended book:
A popular account written by one of the original researchers of stereotype threat:
Steele, C. (2010). *Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do.* New York, NY: W. W. Norton.

Mindset

A brief synopsis:
Mindsets (Dweck, 2006) are beliefs—beliefs about yourself and your most basic qualities, such as intelligence, talents, and abilities. People with a fixed mindset believe that their traits are just givens. They have a certain amount of brains and talent and nothing can change that. They also believe that talent alone creates success—without effort. People with a growth mindset, on the other hand, see their qualities as things that can be developed through their dedication and effort. Given that mathematics can be a challenging field of study, teaching/adopting a growth mindset would be beneficial for math majors.

Dweck, C. S. (2006). *Mindset: The new psychology of success.* New York, NY: Random House.

Online resource:
To take a quiz to take to see what mindset you have, and to learn how you can adjust your mindset to have a growth outlook, visit http://mindsetonline.com