AHSE 2199: Special Topics in Arts, Humanities, Social Sciences:

Teaching and Learning in Undergraduate Science & Engineering[1]

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SYLLABUS

This course will examine select topics in teaching and learning in undergraduate science, technology, engineering, and mathematics (STEM) courses. The goal of the course is to help participants become effective tutors, teaching assistants, mentors, and future instructors in these fields. In a seminar format, participants will discuss research on best practices in pedagogy and curriculum design, cognition and learning, student classroom experiences, motivational theories, diversity, and assessment. Participants will gain experience in instructional design, pedagogy, and assessment, and will develop a teaching portfolio.

Course goals:

This course is designed to help participants become more effective teachers of students of all ages, with specific emphasis on undergraduate education in science and engineering. To this end, the students in this course will 1) become familiar with current research on how students learn science and on effective teaching practices, 2) analyze theoretical and practical aspects of effective teaching and learning practices; 3) actively engage in using the teaching strategies discussed throughout the class, and 4) design and implement their own successful pedagogic approaches. To do so, students will use multiple representations (written narratives, oral presentations, graphs diagrams, equations, etc.) to communicate their teaching strategies. Students will also implement self-directed learning strategies, including learning initiation (e.g., goal-setting and selection of learning strategies), conduct of learning (e.g., time and resource management, motivation management), and learning conclusion (e.g., self-reflection, self-assessment, and goal setting for next activities). The following competencies will be developed through achievement of these goals: qualitative analysis, communication, lifelong learning, and teamwork.

Specific outcome-related objectives:

By the end of this course students will:

1) Develop a teaching portfolio described below
2) Design and implement a lesson plan or unit

[1] This course is based on the initial 2-credit version delivered by Ms. Rebecca B. Miller, Ph.D. candidate at Harvard Graduate School of Education, in the Spring of 2010 to whom we are indebted for her original vision, passion, insight, and class materials, including this very syllabus.

Student expectations:

In this class, an environment of co-creation of knowledge and competencies relevant to teaching and learning will be established through deep engagement and participation in the course discussions and activities. Students will be involved in analysis of teaching and learning strategies relevant to their experiences at Olin and their long-term professional goals. Participants will read about and practice teaching strategies for undergraduate STEM classes. Students must be prepared to engage deeply and participate vigorously in the course discussions and activities. Participants will often share their experiences and writings about the process of trying out new pedagogies. Therefore, students in this course must be open to giving and receiving constructively critical feedback and working towards raising the overall quality of teaching within the class community.

Students with disabilities who are taking this course and who need disability-related accommodations are encouraged to speak with the instructors about their needs. Rod Crafts, Dean of Student Life, Alison Black and Nick Tatar, Assistant Deans for Student Life, are available to assist students in arranging these accommodations.

Workload:[2]

The students will be meeting in class for 2hr 40 min each week to join in rigorous discussion, analysis and synthesis of the material read prior to the class session. Participants should expect to spend about 9 hours each week outside of the class reading assigned materials (about 4-5 hr/week), completing written assignments, and working towards the final portfolio. In addition, it is strongly recommended that each student meets with the faculty outside of class at least once a week to allow for extended brainstorming, delving deeper into the topics relevant to her/his learning goals and teaching portfolios. These individual meetings will be considered to be students' participation in the class and will count towards that portion of assessment (see below.)

Assessment:

This course will help students develop both written and oral communication competencies through weekly written assignments as well as in-class discussions based on the assigned readings. These weekly assignments will provide a basis for the final project, in which students will investigate one pedagogical innovation in more depth (e.g., project-based learning), and present a final oral and written deliverable about how to adapt this pedagogical tool/approach to a particular class at Olin or elsewhere. The oral presentations will be open to the Olin community. Course grades will be allocated as follows: class participation (15%), individual assignments (50% total), final project (20%), and a teaching portfolio (15%).

[2] NOTE on use of laptops: although laptops and other technology may be used towards achievement of the course goals, students are asked to refrain from the use of their personal computers during classes to allow for full participation in class discussions and other activities.

Assignments:

Participation: Students are expected to attend each class session. If a student must miss a class meeting due to illness or extenuating circumstances, she/he is responsible for letting teaching faculty know about this absence in advance. To compensate for missing class, a student will be asked to write an essay about the week's readings in order to support her/him in engaging with, analyzing, and extending the material.

Students should read all of the assigned readings before class and arrive prepared to discuss them in depth. All readings will be available on Public. During some weeks, students will be asked to prepare a presentation or lead discussion in class; this will constitute a portion of students' participation requirement.

Weekly written assignments: Each week students will be asked to complete a short written assignment (typically 1-2 pages) designed to contribute to their understanding of and skills related to teaching and learning in STEM fields. These assignments provide a basis for the final project, described below. Students will be provided with details about each assignment in class, along with criteria for evaluating them. Weekly assignments should be placed in the individual folders within our course folder on Public *by 9 am on the day they are due*.

Final project: The final project for this course is to develop, practice, and analyze a lesson or unit on some scientific or engineering topic. Lesson or unit should be designed to take anywhere from 1 to 3 hours of instructional time. The lesson/unit design should be grounded in the course content and so should reflect thoughtful consideration and incorporation of topics addressed throughout the semester (e.g., motivational theories, effective assessment, etc.). In particular, students should investigate and incorporate into their lesson/unit some pedagogical innovation(s) that have been discussed during the course, or that students identify and discuss in advance with the instructors. Students should also conduct at least one practice teaching session outside of class and, if possible, record it. Students will be able to complete their final project based on class readings, discussions, and written assignments. However, to enrich their experiences students are encouraged to consult additional resources on the chosen content, learners, pedagogies, and assessment techniques, as well as speak with their fellow peers and faculty. The instructors will provide advice on finding these resources.

> *Important note about working with minors: If you intend to devise a project for learners under 18 years of age, you will need to obtain parental permission for their participation in your practice session. Please make an appointment to talk with me about this in the first two weeks of class.*

Students will demonstrate completion of this project in the final weeks of class by delivering an in-class presentation on one aspect of the project and by submitting a teaching portfolio. Presentations will be in class and open to the Olin community. The length of the oral presentation will depend on course enrollment. The goals, content, and assessment rubrics of these presentations will be discussed later in the course.

Teaching portfolio: The portfolios will be due **on the day the Final Exam** is scheduled for the course.

These should be in digital form; however, if you would like to share some materials that may not be digitized, please do so by speaking to the instructors in advance. Portfolios will be modeled on those required by faculty search committees in higher education. An increasing number of colleges and universities require individuals applying for faculty positions to submit a portfolio to demonstrate experience and expertise in teaching. (Most K-12 schools also require portfolios of job applicants, though the contents may vary from those of teachers in higher education. Since this course is primarily focused on undergraduate teaching, the standard higher education portfolio will be used as a model.) As the job market in higher education becomes more competitive, and as institutions become more focused on improving teaching and learning, a candidate with a solid teaching portfolio will often stand out over candidates who do not ably demonstrate their commitment to teaching. The portfolio students create in this course is intended to be a starting place—it should grow and change over the years along with students' experiences and goals.

The final submitted portfolio for this course should include:

1. The lesson or unit plan you develop in this course.
2. Teaching materials you develop throughout the term for use with this lesson (e.g., handouts, assignments, activities, models or simulations, etc.).
3. Essay about your lesson (adapted from weekly assignments and drawing on your practice experience).
4. A teaching philosophy statement.
5. Any prior teaching materials or a resume of prior teaching experience, if available.
6. Samples of student work, recordings or photos of your teaching, and/or evaluations of your teaching, if available.

NOTE: **There will be absolutely no late assignments accepted**; therefore, please plan your schedule well in advance. This is important both for the common assignments and for your individualized work. Please, note that all of your work is subject to the ***Olin College Honor Code*** and any violation of this code may result in disciplinary measures from the College.

Course at a glance:

Week	Date	Module	Reading	Written assignment	In-Class Activities	Ongoing final project-related work
1	09/06	Introduction	Engineering Education and Olin		Class Discussion	
2	09/13	Purposes, Objectives, and Curriculum in Science and Engineering Education	Purposes, Objectives vis-a-vis Teaching Philosophy	Essay on Teaching Philosophy	Class/small group discussions	Brainstorm final deliverable topic and target learner population
3	09/20		Purposes, Objectives vis-a-vis Course Design	Essay on purposes and objectives within course design	Class/small group discussions	
4	09/27	Cognition and Learning in STEM	"Applied Philosophy" of Cognition	Analysis of cognitive dimensions	Class Discussion	Identify target learners
5	10/04	Pedagogical Practices	Traditional and Interactive Lectures Integrated / Interdisciplinary Learning	Analysis of pedagogical choice for a lesson plan on the basis of the week's readings	In-class presentations on pedagogy readings by 2 individual focus groups Class Discussion	Arrange a practice date for a lesson with target learners
6	10/11		Project- and Problem-Based Learning Teamwork / Cooperative Learning	Analysis of pedagogical choice for a lesson plan on the basis of the week's readings		Finalize final deliverable topic
7	10/ 18		Spiral Curriculum, Case Studies OR Technology in Classroom, Labs	Analysis of pedagogical choice for a lesson plan on the basis of the week's readings		Brainstorm lesson plan goals and objectives
8	10/25	Student Experiences in STEM Classrooms	Barriers in Creating Positive Student Experiences in STEM Classrooms	Draft lesson plan with analysis of the final pedagogical choices	Class Discussion Faculty Panel	Finalize pedagogical choices for the final deliverable
9	11/01		Solutions to Creating Positive Student Experiences in STEM Classrooms	Analysis of and approaches to creating positive student experiences	Class/small group discussions	Prepare ancillary materials

10	11/08	Theories of Motivation	Self-Determination, Self-Regulation, Goal Orientation, etc.	Lesson plan draft with analysis of pedagogical choice-student motivation relationship	Class Discussion Faculty Panel	Refine lesson plans, finalize any ancillary teaching materials
11	11/15	Assessment	Grading, Testing, Portfolios, Concept Maps, Rubrics, etc	Draft of assessment plans and analysis	Class/small group discussions	Define assessment plan and relevant rubrics
12	11/29	Teaching Diverse Student Populations	Gender, Race, Culture, Disability, Sexual Orientation, etc	Essay on addressing diversity in STEM classroom	Class/small group discussions	Complete a practice teaching session
13	12/06	Final Presentations		Draft of final lesson plans and portfolios	Final Team Presentations	Compile final portfolio
14	12/13	FINALS WEEK		Portfolios due		

Topic and Reading Schedule

Weeks 1 - 3:

Purposes, Objectives, & Curriculum in Science and Engineering Education

Week 1:

Required Reading:

- "Invention 2000." Olin College document, 1 – 10.
- Kerns, David. *Vision of the College*, 1 – 7. 2007.
- Kerns, Sherra, et al. "Designing from a Blank Slate: The Development of the Initial Olin College Curriculum." In *Educating the Engineer of 2020*, 44 – 51. Washington, DC: National Academies Press, 2005.

Week 2:

Required Reading:

- Bain, Ken. "How do they Prepare to Teach?." In *What the Best College Teachers Do*, 48 – 67. Cambridge: Harvard University Press, 2004.
- Fink, L. Dee. "A Taxonomy of Learning." In *Creating Significant Learning Experiences: An Integrated Approach to Designing College Courses*, 27 – 59. San Francisco: Jossey-Bass, 2003.
- Wright, et al. "Improving Undergraduate Science Teaching Through Educational Research." In *Reform in Undergraduate Science Teaching for the 21st Century,* 1 – 16. Greenwich: Information Age Publishing, 2004.
- "Guideposts to the Future." In *Educating the Engineer of 2020*, 22 – 34. Washington, DC: National Academies Press, 2005.
- O'Brien, Judith G. "Focus on Learning." In *The Course Syllabus*, 1 – 36. San Francisco: Jossey-Bass, 2008.
- Coppola, Brian P. "Writing a Statement of Teaching Philosophy: Fashioning a Framework for Your Classroom." In *Journal of College Science Teaching,* 31, No. 7 (2002): 448 – 453.
- Schonwetter, et al. "Teaching Philosophies Reconsidered: A Conceptual Model for the Development and Evaluation of Teaching Philosophy Statements." In *The International Journal for Academic Development*, 7, No. 1 (2002): 83 – 97.

Recommended/Optional:

- McCormick, Bonnie. "Science Education Reform and Higher Education: A Historical Perspective." In *Reform in Undergraduate Science Teaching for the 21st Century*, 17 – 31. Greenwich: Information Age Publishing, 2004.

Week 3:

Required Reading:

- Posner, George. "A Framework for Course Design." In *Course Design: A Guide to Curriculum Development for Teachers*, 7 – 43, 67 – 75. New York: Longman, 1986.

- Nilson, Linda. "Course Design by Objectives." In *Teaching at Its Best*, 17 – 26. Bolton: Anker Publishing Company, 1997.
- Chapters 4, 7, and possibly 8, Sheri Sheppard, *Educating Engineers: Designing for the Future of the Field*, San Francisco: Jossey-Bass, (2008), 31 – 38, 61 – 74.
- Saunders, Shari and Kardia, Diana. "Creating Inclusive College Classrooms." *University of Michigan*. http://www.crlt.umich.edu/gsis/P3_1.php.
- Tai, Robert and Sadler, Philip. "Factors Influencing Success in Introductory College Chemistry." In *Journal of Research in Science Teaching*, 42, No. 9 (2005): 987 – 1012.
- Sadler, Philip and Tai, Robert. "The Role of High School Physics in Preparing Students for College Physics." In *The Physics Teacher,* 35, (1997): 282 – 285.
- Felder, Richard and Brent, Rebecca. "The ABC's of Engineering Education: ABET, Bloom's Taxonomy, Cooperative Learning, and So On." In *Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition*, 2004.
- Felder, Richard and Brent, Rebecca. "Designing and Teaching Courses to Satisfy the ABET Engineering Criteria." In *Journal of Engineering Education,* 92, No. 1, (2003): 7 – 25.
- Slavkin, Michael and Wilderman, Melba. "Learning through Themes." In *Authentic Learning: How Learning about the Brain can Shape the Development of Students*. Lehman: Rowman & Littlefield Education, 2004, 89 – 113.

Week 4:

Cognition and Learning in STEM

Required Reading:

- Rauhut, Nils. "What Do We Know?" and "Empiricism." In *The Big Questions: Philosophy for Everyone* New York City: Longman Publishing Group, 2005, 62 – 72, 89 – 93.
  - A note: it is recommended that you complete this reading BEFORE the others if you are not familiar with the definitions of knowledge, epistemology, and empiricism.
- Gilbert, John K., and Boulter, Carolyn J. "Learning Science Through Models and Modeling." In *International Handbook of Science Education*, ed. Fraser and Tobin, New York City: Springer Publisher, 1998, 53-66.
- Chinn, Clark A. & Brewer, William F. "Theories of Knowledge Acquisition." In *International Handbook of Science Education,* ed. Fraser and Tobin, New York City: Springer Publisher, 1998, 97-114.
- Novak, J.D. "Learning Science and the Science of Learning." In *Handbook of College Science Teaching*, ed. Mintzes and Leonard, Arlington: NSTA Press, 2006, 119 – 128.
- Brown, A. S., Collins, A., and Duguid, P. "Situated Cognition and the Culture of Learning." In *Educational Researcher*, 18, No. 1, (1989), 32-41.
- Edmonson, K. M. and Novak, J. D., "The Interplay of Scientific Epistemological Views, Learning Strategies, and Attitudes of College Students." In *Journal of Research in Science Teaching,* 32, (1993), 547-559.
- Strike, K. and Posner, G. "A Conceptual Change View of Learning and Understanding." In *Cognitive Structure and Conceptual Change*, Michigan: Academic Press, 1985, 211 – 231.
- Nilson, Linda. "Teaching to Different Styles." In *Teaching at Its Best,* Bolton: Anker Publishing Company, 1997, 79 – 86.
- Hewson, Peter, et al. "Teaching for Conceptual Change." In *International Handbook of Science Education,* ed. Fraser and Tobin, New York City: Springer Publisher, 1998, 199 – 218.
- Jonathan Drori, "What We Think We Know." available from http://www.ted.com/talks/lang/eng/jonathan_drori_on_what_we_think_we_know.html

Weeks 5-7:
Pedagogical Practices

Required Reading:

- Treagust, D. "General Instructional Methods and Strategies." In *Handbook on Research in Science Education*, ed. S. Abell, & N. Lederman, Mahwah: Lawrence Erlbaum Associates, 2007, 373 – 391.
- Middlecamp, C. "Diversity in the Physical Science Curriculum: The Intellectual Challenge." In *Handbook of College Science Teaching*, ed. Mintzes and Leonard, Arlington: NSTA Press, 2006, 279 – 288.

TED Talks:

These are not required, but they are absolutely fascinating (as many TED talks are). TED talks are 10-20 minute presentations on a variety of topics, which may prove useful for certain focus groups.

- Sugata Mitra, "The Child-Driven Education." available from http://www.ted.com/talks/lang/eng/sugata_mitra_the_child_driven_education.html
- David Merrill, "Siftables: The Smart Blocks." available from http://www.ted.com/talks/lang/eng/david_merrill_demos_siftables_the_smart_blocks.html
- Ali Carr Chellman, "Gaming to Re-engage Boys in Learning." available from http://www.ted.com/talks/lang/eng/ali_carr_chellman_gaming_to_re_engage_boys_in_learning.html
- Annmarie Thomas, "Hands-on Science with Squishy Circuits." available from http://www.ted.com/talks/lang/eng/annmarie_thomas_squishy_circuits.html
- Arthur Benjamin, "Arthur Benjamin's Formula for Changing Math Education." available from http://www.ted.com/talks/lang/eng/arthur_benjamin_s_formula_for_changing_math_education.html
- Charles Leadbeater, "Education Innovation in the Slums." available from http://www.ted.com/talks/lang/eng/charles_leadbeater_on_education.html
- Conrad Wolfram, "Teaching Kids Real Math with Computers." available from http://www.ted.com/talks/lang/eng/conrad_wolfram_teaching_kids_real_math_with_computers.html
- Gever Tulley, "Life Lessons through Tinkering." available from http://www.ted.com/talks/lang/eng/gever_tulley_s_tinkering_school_in_action.html
- Arvind Gupta, "Turning Trash into Toys for Learning." available from http://www.ted.com/talks/lang/eng/arvind_gupta_turning_trash_into_toys_for_learning.html

Week 5:

Traditional and Interactive Lectures

Required Reading:

- Bain, K. "How Do They Conduct Class?" In *What the Best College Teachers Do*, Ken Bain (Harvard University Press, 2004), 98 – 134.
- Mazur, E. and Watkins, J. "Just in Time Teaching and Peer Instruction." In *Just-in-Time Teaching: Across the Disciplines, Across the Academy*, ed. Simkins and Maier, Sterling: Stylus Publishing, 2009, ed. Mintzes and Leonard, Arlington: NSTA Press, 2006, 39 – 62.
- Burgan, M. "The Myth of the Bloviating Professor: Sages and Guides." In *What Ever Happened to the Faculty? Drift and Decision in Higher Education,* Baltimore: Johns Hopkins University Press: 2006, 24-48.
- Harvard's Science and Cooking: http://www.youtube.com/watch?v=gAbpLfKtBXY

Focus Group Reading:

- Rosenberg, J., Lorenzo, M., and Mazur, E. "Peer Instruction: Making Science Engaging." In *Handbook of College Science Teaching*, ed. Mintzes and Leonard, Arlington: NSTA Press, 2006, 77-86,
- Hollander, J. "Learning to Discuss: Strategies for Improving the Quality of Class Discussion." In *Teaching Sociology,* 30, No. 3, (2002), 317 – 327.
- Mowshowitz, D. *A Seminar Leader's Manual,* (Columbia University, 2004)
- Davies, J. "What Makes a Good Engineering Lecturer?" In *European Journal of Engineering Education,* 31, No. 5, (2006), 543 – 553.
- Michael, J. "Where's the Evidence that Active Learning Works?" In *Advances in Physiology Education*, 30, (2006), 159 – 167.
- Ueckert, C. and Gess-Newsome, J. "Active Learning in the College Science Classroom." In *Handbook of College Science Teaching*, ed. Joel J. Mintzes, William H. Leonard, Arlington: NSTA Press, 2006, 147 – 154.
- Milner-Bolotin, M. "Clickers Beyond the First-Year Science Classroom." In *Journal of College Science Teaching,* 40, No. 2, (2010), 14 – 18.

Integrated/Interdisciplinary Learning

Required Reading:

- Froyd, J. E. and Ohland, M. "Integrated Engineering Curricula." In *Journal of Engineering Education*, (2005), 147 – 164.
- Everett, L. J., et al. "Integrated Curricula: Purpose and Design." In *Journal of Engineering Education*, (2000), 167 – 175,
- Lederman, N. G., and Niess, M. "Integrated, Interdisciplinary, or Thematic: Is it a Question? Or Is it Questionable Semantics?" In *School Science and Mathematics,* 97, No. 2, (1997), 57 – 58.
- Huntley, M. "Design and Implementation of a Framework for Defining Integrated Mathematics and Science Education." In *School Science and Mathematics,* 98, No. 6, (1998), 320 – 327.
- Czerniak, C. M. "A Literature Review of Science and Mathematics Integration." In *School Science and Mathematics,* 99, No. 8, (1999), 421 – 430.

Focus Group Reading:

- Lonning, R., and DeFranco, T. "Development of Theme-based, Interdisciplinary, Integrated Curriculum: A Theoretical Model." In *School Science and Mathematics,* 97, No. 4, (1998), 211 – 215.
- Bordogna, J., et al. "Engineering Education: Innovation Through Integration." In *Journal of Engineering Education,* (1993), 3 – 8.

- Laughlin, C., Zastavker, Yevgeniya V., and Ong, Maria. "Is Integration Really There? Students' Perceptions of Integration in Their Project-Based Curriculum." In *ASEE/IEEE Frontiers in Education Conference*, (2007)
- Al-Holou, N., et al. "First Year Integrated Curricula: Design Alternatives and Examples." In *Journal of Engineering Education*, (1999), 435 – 448.

Week 6:

Project- and Problem-Based Learning (PjBL and PBL)

Required Reading:

- Barron, B., et al. "Doing with Understanding: Lessons from Research on Project- and Problem-Based Learning." In *Journal of the Learning Sciences,* 7, No. 3/4, (1998), 271 – 311.
- Morgan, A. "Theoretical Aspects of Project-Based Learning in in Higher Education." In *British Journal of Educational Technology,* 1, Vol. 14, (1983), 66 – 78.
- Perrenet, J. C., et al. "The Suitability of Problem-Based Learning for Engineering Education: Theory and Practice." *Teaching in Higher Education,* 5, No. 3, (2000), 345 – 358.
- Blumenfeld, P. "Motivating Project-Based Learning: Sustaining the Doing, Supporting the Learning." In *Educational Psychologist,* 26, No. 3 & 4, (1991), 369 – 398.

Focus Group Reading:

- Mills, J. and Treagust, D. "Engineering Education – Is Problem-Based or Project-Based Learning the Answer?" In *Australasian Journal of Engineering Education*, (2003), 2 – 16.
- Choose one of the following:
  - Strobel, J. and van Barneveld, A. "When is PBL More Effective – A Meta-synthesis of Meta-analyses Comparing PBL to Conventional Classrooms." In *Interdisciplinary Journal of Problem-Based Learning,* 3, No.1 (2009), 44 – 58.
  - Walker, A. and Leary, H. "A Problem Based Learning Meta Analysis: Differences Across Problem Types, Implementation Types, Disciplines, and Assessment Levels." In *Interdisciplinary Journal of Problem-Based Learning,* 3, No. 1 (2009), 12 – 43.
- Heitmann, G. "Project-Oriented Study and Project-Organized Curricula: A Brief Review of Intentions and Solutions." In *European Journal of Engineering Education*, 21, Vo. 2, (1996), 121 – 131.

Teamwork/Cooperative Learning

Required Reading:

- Harmon, S., James, W., and Bryant, R. "Matching Team Activities to Individual Learning Goals?" In *American Society for Engineering Education,* (2007),
- Blumenfeld, P., et al. "Learning with Peers: from Small Group Collaboration to Collaborative Communities." In *Educational Researcher,* 25*, No.8,* (1996), 37 – 40.
- McAnear, T. and Seat, E. "Gender Perceptions of Team Performance." In *ASEE/IEEE FIE Conference*, (2001).
- Tonso, K. "Teams that Work: Campus Culture, Engineer Identity, and Social Interactions." In *Journal of Engineering Education*, (2006), 25 – 37.

Focus Group Reading:

- Kalman, C. "Collaborative Groups" and "Selected Methods for Using Collaborative Groups." In *Successful Science and Engineering Teaching in Colleges and Universities,* Bolton: Anker Publishing, 2007, 73 – 96.
- Schmidt, L. "Engineering Teams: Individual or Group Sport?" In *International Journal of Engineering Education*, 22, No. 3, (2006), 659 – 664.

- Heller, P. and Hollabaugh, M. "Teaching Problem Solving through Cooperative Grouping. Part 2: Designing Problems and Structuring Groups." In *American Journal of Physics*, 60, No. 7, (1992), 637 – 644.
- Linder, B. et al. "Taking One for the Team: Goal Orientation and Gender-Correlated Task Division." In *ASEE/IEEE FIE Conference*, (2010).
- Oakley, B., et al. "Turning Student Groups into Effective Teams." *New Forums Press*, 2, No. 1, (2004), 9 – 34
- Leonard, J., et al. "Discovering Functional Role Specialization: The Effect on Undergraduate Student Learning of Engineering Project Teams." In *Proc. National STEM Assessment Conference,* (2006), 240 – 246.
- Scott, L. and Heller, P. "Team Work Works! Strategies for Integrating Women and Minorities into the Physical Sciences." In *The Science Teacher*, 58, No.1, (1991), 24 – 28.

Week 7:

Choice of Special Topics: Spiral Curriculum

Required Reading:

- Harden, R. M., and Stamper, N. "What is a Spiral Curriculum?" In *Medical Teacher*, 21, No. 2, (1999), 141 – 143.
- Dibasio, D., et al. "Evaluation of a Spiral Curriculum for Engineering." In *ASEE/IEEE FIE Conference,* (1999).
- Dowding, T. "The Application of a Spiral Curriculum Model to Technical Training Curricula." In *Educational Technology,* (July 1993), 18 – 28.

Focus Group Reading:

- Clark, W., et al. "A Project-Based Spiral Curriculum for Intro Courses in ChE – Curriculum Design." In *Chemical Engineering Education,* 34, No. 3, (1998), 222 – 229.
- Dixon, A., et al. "A Project-Based Spiral Curriculum for Intro Courses in ChE – Implementation." In *Chemical Engineering Education,* (2000), 296 – 303.
- DiBiasio, D., et al. "A Project-Based Spiral Curriculum for Intro Courses in ChE – Evaluation." In *Chemical Engineering Education,* (2001), 140 – 147.
- Cowan, P. "Evidence of a Spiral Curriculum Using a Mathematical Problem-Solving Tool." In *Interactive Learning Environments,* Vol. 6, No. 3,2010), 205 – 224.
- Lohani, V., et al. "Spiral Curriculum Approach to Reformulate Engineering Curriculum." In *ASEE/IEEE FIE Conference*, (2005).
- Armstrong, J. "The Relative Effects of Two Forms of Spiral Curriculum Organization and Two Modes of Presentation on Mathematical Learning." (Thesis), University of Wisconsin, (1942).

Choice of Special Topics: Case Studies

Required Reading:

- One of the following:
  - Herreid, C. "Using Case Studies to Teach Science."In *Handbook of College Science Teaching*, ed. Joel J. Mintzes, William H. Leonard, Arlington: NSTA Press, 2006, 177 – 184.
  - Herreid, C. "Case Studies in Science: A Novel Method of Science Education." In *Start with a Story: The Case Study Method of Teaching College Science,* Arlington: NSTA Press, 2006, 29 – 39.

  Chen, L., et al. "Cooking Under Pressure: Applying the Ideal Gas Law in the Kitchen." In *Journal of College Science Teaching,* 40, No. 2, (2010), 76 – 78.
- Harvard's Science and Cooking: http://www.youtube.com/watch?v=gAbpLfKtBXY

Focus Group Reading:

- Stake, R. "Case Study Method." In *Complementary Methods for Research in Education,* ed. Richard Jaeger, Washington, D.C.: American Educational Research Association, 1997, 401 – 446.
- Lundeberg, M. "Case Pedagogy in Undergraduate STEM: Research We Have, Research We Need.", 2008, 1 – 18.
- Yadav, A., et al. "Lessons Learned: Implementing the Case Teaching Method in a Mechanical Engineering Course." In *Journal of Engineering Education,* (2010), 55 – 69.

- Tobias, S. and Herreid, C. "Alien Evolution - A Futuristic Case Study: The Return of the Cambrian Explosion." In *Start with a Story: The Case Study Method of Teaching College Science,* Arlington: NSTA Press, 2006, 253 – 263.
- Herreid, C. "Dialogues as Case Studies – A Discussion on Human Cloning: Creating Drama and Controversy in the Science Classroom." In *Start with a Story: The Case Study Method of Teaching College Science,* Arlington: NSTA Press, 2006, 239 – 245.
- Allen, B. and Herreid, C. "The Petition: A Global Warming Case Study." In *Start with a Story: The Case Study Method of Teaching College Science,* Arlington: NSTA Press, 2006, 161 – 166.
- Nathan Myhrvold, "Cooking as never seen before", available from http://www.ted.com/talks/nathan_myhrvold_cut_your_food_in_half.html

Choice of Special Topics: Technology in the Classroom

Required Reading:

- Bourne, J., et al. "Online Engineering Education: Learning Anywhere, Anytime." In *JALN,* 9, No. 1, (2005), 15 – 41
- Moore, J. "Don't Make Me Think! I'm Trying to Teach: Designing Web Environments that Enrich Teachers' Work." In *Better Teaching and Learning in the Digital Classroom*, ed. David Gordon, Cambridge: Harvard Education Press, 2003, 65 – 78.
- Prensky, M. "The Digital Game-Based Learning Revolution." *Digital Game-Based Learning*, New York: McGraw-Hill, 2001, 9 – 34.

Focus Group Reading:

- Norris, C. and Soloway, E. "How Handhelds Can Have an Impact in the Classroom: The Teacher Perspective." In *Better Teaching and Learning in the Digital Classroom*, ed. David Gordon, Cambridge: Harvard Education Press, 2003, 65 – 78.
- Klopfer, E. "Education Innovation through Time." In *Augmented Learning – Research and Design of Mobile Educational Games*, Cambridge: MIT Press, 2008, 1 – 12
- Klopfer, E. "The Aftermath of Math Blaster." In *Augmented Learning – Research and Design of Mobile Educational Games*, Cambridge: MIT Press, 2008, 23-32
- Shaffer et al. "Video Games and the Future of Learning." University of Wisconsin-Madison, 2004)
- Yarnall, L. "Online Distance Learning: Is it Worth the Cost and Effort?" In *Better Teaching and Learning in the Digital Classroom*, Cambridge: Harvard Education Press, 2003, 93 – 110.

Choice of Special Topics: Labs

Required Reading:

- Feisel, L. and Rosa, A. "The Role of the Laboratory in Undergraduate Engineering Education." In *Journal of Engineering Education*, (2005), 121 – 130.
- Sheppard, S. "Lab in the Curriculum." "Learning in the Lab." and "Lab Reports." In *Educating Engineers: Designing for the Future of the Field*, San Francisco: Jossey-Bass, 2008, 69 – 87.
- Carlson, L. and Sullivan, J. "Hands-on Engineering: Learning by Doing in the Integrated Teaching and Learning Program." In *International Journal of Engineering Education*, 15, No. 1, (1999), 20 – 31.
- Harvard's Science and Cooking: http://www.youtube.com/watch?v=gAbpLfKtBXY

Focus Group Reading:

- Edward, N. "The Role of Laboratory Work in Engineering Education: Student and Staff Perceptions." In *International Journal of Electrical Engineering Education*, 39, No. 1,(2002), 11 – 19.
- Ogot, M., et al. "An Assessment of In-Person and Remotely Operated Laboratories." In *Journal of Engineering Education*, (2003), 57 – 64.
- King, R. et al. "A Multidisciplinary Engineering Laboratory Course." In *Journal of Engineering Education*, (1999), 311 – 316.
- Pickering, M. "Laboratory Education as a Problem in Organization." In *Journal of College Science Teaching*, 16, No. 3, (1986), 187 – 189.

Weeks 8-9:
Student Experiences in STEM Classrooms

Week 8: Issues with Student Experiences in STEM Classes

Required Reading:

- Mallow, J. "Science Anxiety: Research and Action." In *Handbook of College Science Teaching*, Joel J. Mintzes, William H. Leonard (eds.) Arlington: NSTA Press, 2006, 3 – 14.
- Beilock, S. "Female Teachers' Math Anxiety Affects Girls' Math Achievement." In *PNAS Early Edition*, (2009), 1 – 4.
- Seymour, E. and Hewitt, N. "The Learning Experience in S.M.E. Majors." In *Talking about Leaving: Why Undergraduates Leave the Sciences,* Boulder: Westview Press, 1997, 88 – 177.
    - *If you're interested in this reading, you may also be interested in the following one, which is similar to the Seymour and Hewitt in content, but rather focuses on graduate students*: Herzig, A. "Where Have All the Students Gone? Participation of Doctoral Students in Authentic Mathematical Activity as a Necessary Condition for Persistence toward the Ph. D." In *Educational Studies in Mathematics,* 50, 2002, 177 – 212.
- Lipson, A. "The Confused Student in Introductory Science." In *College Teaching*, 40, No. 3, (1992), 91-95.
- Aschbacher, P. "Is Science Me? High School Students' Identities, Participation and Aspirations in Science, Engineering, and Medicine." In *Journal of Research in Science Teaching*, (2009), 1 – 19.
- Turner, P. and Curran, A. "Correlates between Bioscience Students Experiences of Higher Education and the Neurobiology of Learning" In *Bioscience Education Journal,* Vol. 7, (2006).
- Burkam, D., et al. "Gender and Science Learning Early in High School: Subject Matter and Laboratory Experiences." In *American Educational Research Journal,* 34, No. 2, (1997), 297 – 331.

Week 9: Solutions to Issues from 1st Week

- Hutchison-Green, M., et al. "Providing a Voice: Qualitative Investigation of the Impact of a First-Year Engineering Experience on Students' Efficacy Beliefs." In *Journal of Engineering Education*, (2008) 177 – 190.
- Hidi, S. and Harackiewicz, J. "Motivating the Academically Unmotivated: A Critical Issue for the 21st Century." In *Review of Educational Research,* 70, No. 2, (2000), 151 – 179.
- Neumann, R. "The Teaching-Research Nexus: Applying a Framework to University Students' Learning Experiences." In *European Journal of Education,* 29, No. 3, (1994), 323 – 338.
- Seron, C. and Silbey, S. "A Day in the Life: Inventing Engineers." Seron and Silbey, *American Sociological Association,* (2005).
- Milto, E. et al. "Gender Differences in Confidence Levels, Group Interactions, and Feelings about Competition in an Introductory Robotics Course." In *ASEE/IEEE FIE Conference*, (2002).
- Trenor, J., et al. "The Relations of Ethnicity to Female Engineering Students' Educational Experiences and College and Career Plans in an Ethnically Diverse Learning Environment." In *Journal of Engineering Education,* (2008), 449 – 464.
- Fraser, B. and Tobin, K. "The Teacher Factor in the Social Climate of the Classroom." In *International Handbook of Science Education*, ed. Fraser and Tobin, New York City: Springer Publisher, 1998, 565 – 580.

- Soulsby, E. "University Learning Skills: A First Year Experience Orientation Course for Engineers." In *ASEE/IEEE FIE Conference*, (1999).
- Tatar, N., et al. "Work in Progress – Using Video and Self-Reflection to Enhance Undergraduate Teams." Tatar *et al. ASEE/IEEE Frontiers in Education Conference,* (2010)
- Nicholls, J., et al. "Assessing Students' Theories of Success in Mathematics: Individual and Classroom Difficulties" In *Journal for Research in Mathematics Education*, 21, No. 2, (1990), 109 – 122.

Week 10: Theories of Motivation

Required Reading:

- Eccles, J. and Wigfield, A. "Motivational Beliefs, Values, and Goals." In *Annual Review of Psychology*, 53, (2002), 109 – 132.
- Church, M., Elliot, A., and Gable, S. "Perceptions of Classroom Environment, Achievement Goals, and Achievement Outcomes." In *Journal of Educational Psychology,* 93, No. 1, (2001), 43 – 54.
- Pintrich, P., et al. "Current Issues in Achievement Goal Theory and Research." In *International Journal of Education Research,* 39, (2003), 319 – 337.
- Katz, I. and Assor, A. "When Choice Motivates and When it Does Not." In *Educational Psychology Review*, (2007), 429 – 442.
- Debacker, T. and Nelson, M. "Motivation to Learn Science: Differences Related to Gender, Class Type, and Ability." In *Journal of Educational Research,* 93, No. 4*,* (2000), 245 – 271.
- Stefanou, C. "Supporting Autonomy in the Classroom: Ways Teachers Encourage Student Decision Making and Ownership." In *Educational Psychologist,* 39, (2004) 97 – 110.
- Vallerand, R. J. "Deci and Ryan's Self-Determination Theory: A View From the Hierarchical Model of Intrinsic and Extrinsic Motivation." In *Psychological Inquiry*, 11, No. 4, (2000), 312-318.

Additional/Optional Reading:

- Pajares, F. "Self-Efficacy Beliefs in Academic Settings." In *Review of Educational Research,* 66, No. 4, (1996), 543 – 578.
- Zeldin, A., and Pajares, F. "Against the Odds: Self-Efficacy Beliefs of Women in Mathematical, Scientific, and Technological Careers." In *American Educational Research Journal,* 37, No. 1, (2000), 215 – 246.
- Wolters, C., Yu, S., and Pintrich, P. "The Relation between Goal Orientation and Students' Motivational Beliefs and Self-Regulated Learning." In *Learning and Individual Differences*, 8, No. 3, (1996), 211 – 238.
- Roebken, H. "The Influence of Goal Orientation on Student Satisfaction, Academic Engagement, and Achievement." In *Education & Psychology*, 5, No. 3, (2007), 679 – 704.
- Matusovich, et al. "Why do Students Choose Engineering? A Qualitative, Longitudinal Investigation of Students' Motivational Values." In *Journal of Engineering Education*, (2010), 289 – 303.
- Fisher, A., et al. "Undergraduate Women in Computer Science: Experience, Motivation and Culture." In *ACM SIGCSE Bulletin,* 29, No. 1, (1997), 106 – 110.
- Jones, B., et al. "An Analysis of Motivation Constructs with First-Year Engineering Students: Relationships among Expectancies, Values, Achievement, and Career Plans." In *Journal of Engineering Education*, (2010), 319 – 336.
- Kwiek, N., et al. "Pharmacology in the High-School Classroom." In *Science Magazine*, 317, (2007), 1871 – 1872.
- Ryan, R. and Deci, E. "Self-Regulation and the Problem of Human Autonomy: Does Psychology Need Choice, Self-Determination, and Will?" In *Journal of Personality*, 74, No. 6, (2006), 1557 – 1586.
- Ryan, R. and Deci, E. "Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being." In *American Psychologist,* 55, No.1, (2000) 68 – 78.

- Malka, A. and Covington, M. "Perceiving School Performance as Instrumental to Future Goal Attainment: Effects on Graded Performance." In *Contemporary Educational Psychology*, 30, (2005) 60 – 80.

Videos:

- Daniel Pink, "The Surprising Science of Motivation." 2009) from http://www.ted.com/talks/dan_pink_on_motivation.html
- Sir Ken Robinson, "Schools Kill Creativity." 2006) from http://www.ted.com/talks/ken_robinson_says_schools_kill_creativity.html
- Sir Ken Robinson, "Bring on the Revolution." 2010) from http://www.ted.com/talks/sir_ken_robinson_bring_on_the_revolution.html

Week 10: Assessment

Required Reading:

- Conklin, K. "Due Process in Grading: Bias and Authority." In *The School Review*, 81, No. 1, (1972), 85 – 95.
- Heywood, J. "Practicals, Projects, Problem-based Learning and Portfolios." In *Assessment in Higher Education: Student Learning, Teaching, Programmes and Institutions*, London: Jessica Kingsley Publishers, 2000, 316 – 395.
- Pickering, M. and Herschbach, D. "Making Grading Less Painful." In *Journal of College Science Teaching, (*1991), 377 – 380.
- Scharmann, L., et al. "Assessment in College Science Courses." In *Reform in Undergraduate Science Teaching for the 21st Century*, Greenwich: Information Age Publishing, 2004, 137 – 152.
- Goubeaud, K. "Assessment Practices in College Science: Trends from the National Study of Postsecondary Faculty." In *Handbook of College Science Teaching*, Joel J. Mintzes, William H. Leonard (eds.) Arlington: NSTA Press, 2006, 371 – 379.
- Kapitanoff, S. "Collaborative Testing: Cognitive and Interpersonal Processes Related to Enhanced Test Performance." In *Active Learning in Higher Education*, 10, No. 1, (2009), 56 – 70.
- Tsai, C., et al. "Developing Science Activities through a Networked Peer Assessment System." In *Computers & Education*, 38, (2002), 241 – 252.
- Yorke, M. "Formative Assessment in Higher Education: Moves towards Theory and the Enhancement of Pedagogic Practice." In *Higher Education*, 45, (2003) 477 – 501.
- Turns, J. et al. "Concept Maps for Engineering Education: A Cognitively Motivated Tool Supporting Varied Assessment Functions." In *IEEE Transactions on Education*, 43, No. 2, (2000), 164 – 173.
- Baron, D. "When Professors Get A's and Machines Get F's." In *Chronicle of Higher Education*, (1998), A56.
- Andrade, H. "Teaching with Rubrics: the Good, the Bad, the Ugly." In *College Teaching*, 53, No. 1, 2005), 27 – 30.

Optional/Recommended Reading:

- Gatfield, T. "Examining Student Satisfaction with Group Projects and Peer Assessment." In *Assessment & Evaluation in Higher Education*, 24, No.4, (1999), 365 – 377.
- "Computers Grade Student's Writing." Associated Press*, Wired.com*, May 8, 2005, available from http://www.wired.com/science/discoveries/news/2005/05/67458
- Ben, K. "How Do They Evaluate Their Students and Themselves?" In *What the Best College Teachers Do*, Cambridge: Harvard University Press, 2004, 98 – 134.

Week 11: Teaching Diverse Students

Required Reading:

- Clewell, B. and Campbell, P. "Taking Stock: Where We've Been, Where We Are, Where We're Going." In *Journal of Women and Minorities in Science and Engineering*, 8, (2002), 255 – 284.
- Malone, K. and Barabino, G. "Narrations of Race in STEM Research Settings: Identity Formation and its Discontents." In *Science Education,* (2008), 485 – 510.
- Valian, V. "Gender Schemas at Work." In *Why so Slow?: The Advancement of Women*, Cambridge: MIT Press, 1998, 1 – 22.
- McIntosh, P. "White Privilege: Unpacking the Invisible Backpack." *Wellesley College Center for Research on Women,* (1988).
- Elliott, T. "Making Strange What had Appeared Familiar." *The Monist,* 77, No. 4, (1994), 424 – 433.
- Massey, D. "The Puzzle of the Minority Underachievement." In *The Source of the River: the Social Origins of Freshmen at America's Selective Colleges and Universities*. Princeton: Princeton University Press, 2003, 1 – 19.
- Pomeroy, D. "Science Education and Cultural Diversity: Mapping the Field." In *Studies in Science Education,* 24*, (*1994), 49 – 73.
- Weisberger, R. "Successful Science for Students with Disabilities." In *College Teaching*, 42, No. 2 (1994), 55 – 56.
- Lopez, G. and Chism, N. "Classroom Concerns of Gay and Lesbian Students: The Invisible Minority."In *College Teaching*, 41, No. 3, (1993), 97 – 103.

- Ali Carr Chellman, "Gaming to Re-engage Boys in Learning." available from http://www.ted.com/talks/lang/eng/ali_carr_chellman_gaming_to_re_engage_boys_in_learning.html
  - Some of you may have already watched this when we were studying pedagogy

Optional/Recommended Reading:

- Steele, C. "A Threat in the Air: How Stereotypes Shape Intellectual Identity and Performance." In *American Psychologist*, 57, No. 6, (1997), 613 – 629.
- Marshall, K. "Science, Technology, and the Learning Disabled: A Review of the Literature." In *Handbook of College Science Teaching,* 271 – 278.
- Busch-Vishniac, I. and Jarosz, J. "Can Diversity in the Undergraduate Engineering Population be Enhanced through Curricular Change?" In *Journal of Women and Minorities in Science and Engineering*, 10, (2004), 255 – 281.
- Blickenstaff, J. "Women and Science Careers: Leaky Pipeline or Gender Filter?" In *Gender and Education*, 17, No. 4, (2005), 369 – 386.
- Margolis, J. and Fisher, A. "The Magnetic Attraction." In *Unlocking the Clubhouse: Women in Computing*, Cambridge: MIT Press, 2001, 13 – 32.
- Sands, A. "Never Meant to Survive: A Black Woman's Journey – An Interview with Evelyn Hammonds." In *The Radical Teacher*, 30, (1986), 8 – 15.

- Wu, F. "The Model Minority: Asian American 'Success' as a Race Relations Failure." In *Yellow: Race in America Beyond Black and White,* New York: Basic Books, 2002, 39 – 77.
- People Like Us (PBS Documentary)
  - Option of either watching the video (available in library) or reading its transcript
- Talk by Virginia Valian, "Why So Slow? The Advancement of Women." http://mitworld.mit.edu/video/80/

List of Books and Journals Used in this Course

Books

Bain, Ken. *What the Best College Teachers Do*. Cambridge, MA: Harvard UP, 2004.

Burgan, Mary. *What Ever Happened to the Faculty?: Drift and Decision in Higher Education*. Baltimore, MD: Johns Hopkins UP, 2006.

Educating the Engineer of 2020: Adapting Engineering Education to the New Century. Washington, DC: National Academies, 2005.

Fink, L. Dee. *Creating Significant Learning Experiences: an Integrated Approach to Designing College Courses*. San Francisco: Jossey-Bass, 2003.

Gordon, David T. *Better Teaching and Learning in the Digital Classroom*. Cambridge, MA: Harvard Education, 2003.

Herreid, Clyde Freeman. *Start with a Story: the Case Study Method of Teaching College Science*. Arlington, VA: NSTA, 2007.

Jaeger, Richard M., and Tom Barone. *Complementary Methods for Research in Education*. Washington, DC: American Educational Research Association, 1997.

Kalman, C. S. *Successful Science and Engineering Teaching in Colleges and Universities*. Bolton, MA: Anker Pub., 2007.

Klopfer, Eric. *Augmented Learning Research and Design of Mobile Educational Games*. Cambridge, MA: MIT, 2008.

Margolis, Jane, and Allan Fisher. *Unlocking the Clubhouse: Women in Computing*. Cambridge, MA: MIT, 2001.

Massey, Douglas S. *The Source of the River: the Social Origins of Freshmen at America's Selective Colleges and Universities*. Princeton, NJ: Princeton UP, 2003.

Mintzes, Joel J., and William H. Leonard. *Handbook of College Science Teaching*. Arlington, VA: NSTA, 2006.

Moore, J., *Better Teaching and Learning in the Digital Classroom*, ed. David Gordon, (Harvard Education Press, 2003)

Margolis, Jane, and Allan Fisher. *Unlocking the Clubhouse: Women in Computing*. Cambridge, MA: MIT, 2001.

Mowshowitz, D., *A Seminar Leader's Manual,* (Columbia University, 2004).

Nilson, Linda Burzotta. *Teaching at Its Best: a Research-based Resource for College Instructors*. Bolton, MA: Anker Pub., 2003.

O'Brien, Judith Grunert., Barbara J. Millis, and Margaret W. Cohen. *The Course Syllabus: a Learning-centered Approach*. San Francisco: Jossey-Bass, 2008.

Posner, George J., and Alan N. Rudnitsky. *Course Design: a Guide to Curriculum Development for Teachers*. New York: Longman, 1986.

Prensky, Marc. *Digital Game-based Learning*. New York: McGraw-Hill, 2001.

Rauhut, N., *The Big Questions: Philosophy for Everyone*, Longman, 2005).

Sheppard, S., Kelly Macatangay, and Anne Colby. *Educating Engineers Designing for the Future of the Field*. San Francisco: Jossey-Bass, 2009.

Simkins, Scott, and Mark Maier. *Just-in-time Teaching: across the Disciplines, across the Academy*. Sterling, VA: Stylus Pub., 2010.

Slavkin, Michael L. *Authentic Learning: How Learning about the Brain Can Shape the Development of Students*. Lanham, MD: Scarecrow Education, 2004.

Sunal, Dennis W., Emmett Wright, and Jeanelle Bland. Day. *Reform in Undergraduate Science Teaching for the 21st Century*. Greenwich: Information Age Pub., 2004.
Treagust, D., *Handbook on Research in Science Education*, ed. S. Abell, & N. Lederman, Lawrence Erlbaum Associates, 2007).
Valian, Virginia. *Why so Slow?: the Advancement of Women*. Cambridge, MA: MIT, 1998.
West, Leo H. T., and A. Leon. Pines. *Cognitive Structure and Conceptual Change*. Orlando: Academic, 1985.
Wu, Frank H. *Yellow: Race in America beyond Black and White*. New York: Basic, 2002.

Journals

ACM SIGCSE Bulletin
Active Learning in Higher Education
Advances in Physiology Education
American Educational Research Journal
American Journal of Physics
American Psychologist
American Sociological Association
Annual Review of Psychology
ASEE/IEEE Frontiers in Education Conference Publications
Assessment & Evaluation in Higher Education
Australasian Journal of Engineering Education
Bioscience Educational Journal
British Journal of Educational Technology
Chemical Engineering Education
Chronicle of Higher Education
College Teaching
Computers & Education
Contemporary Educational Psychology
Education & Psychology
Educational Psychologist
Educational Psychology Review
Educational Researcher
Educational Studies in Mathematics
Educational Technology
European Journal of Engineering Education
Gender and Education
Higher Education
IEEE Transactions on Education
Interactive Learning Environments
International Journal of Electrical Engineering Education
Interdisciplinary Journal of Problem-Based Learning
International Handbook of Science Education
The International Journal for Academic Development
International Journal of Engineering Education
International Journal of Education Research

Journal for Research in Mathematics Education
Journal of Asynchronous Learning Networks
Journal of College Science Teaching
Journal of Educational Psychology
Journal of Educational Technology
Journal of Engineering Education
Journal of the Learning Sciences
Journal of Personality
Journal of Research in Science Teaching
Journal of Women and Minorities in Science and Engineering
Learning and Individual Differences
Medical Teacher
The Monist
New Forums Press
The Physics Teacher
PNAS Early Edition
Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition
Proceedings of the National STEM Assessment Conference
The Radical Teacher
Review of Educational Research
The School Review
School Science and Mathematics
Science Education
Science Magazine
The Science Teacher
Studies in Science Education
Teaching in Higher Education
Teaching Sociology