COLLEGE OF EDUCATION and HEALTH PROFESSIONS
Department of Curriculum and Instruction

Course Number: CIED 6313
Title: *Issues, History, and Rationale of Science Education*
Semester: Spring 2009
Time: Tuesdays / 5-8pm
Classroom: PEAH
Credits: 3
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Course Description: This course provides a strong foundation for those interested in the discipline of science education by presenting an overview of the fundamental issues in and vocabulary of the field. The content of this course is based on the rationale that science teachers must know the content of their discipline, science educators are expected to couple science content knowledge and strong teaching skills with an understanding and appreciation for the history of the field, the place of science education in the nation's educational system (including schools and informal sites), the research basis for science teaching, the literature of science education, and issues and controversies surrounding the teaching of science.

Course Objectives:

Issues, History and Rationale of Science Education will examine and discuss:

- the distinction between science teaching and science education;
- the goals for and place of science instruction in schools;
- the history and development of science education;
- the state of science education (Project Synthesis, Bayer Facts, Horizon Research Studies, National Assessment of Educational Progress [NAEP]) and related suggestions for improvement;
- what research says about science instruction and future research needs;
- the legal and safety challenges of science teaching;
- the role and nature of funded and/or kit-based science curriculum projects (such as S-APA, ESS, HOSCS, SCIS, FOSS, AIMS and GEMS);
- philosophical and psychological foundations (process, product, inquiry, history) of science curriculum projects and reform efforts (such as Project 2061, SS&C, S/T/S);
- science literacy and standards (benchmarks & frameworks) in science education;
- cycles of crisis and reform in science education.

Required Materials:

DeBoer, G.E. (1991). *A history of ideas in science education: Implications for practice.* New York: Teachers College Press. (Available in the bookstore). Note: in "Issues" we will not be discussing all of the important topics included in the DeBoer (i.e. Chapters 5, 6 and 10). You are encouraged to read/skim these chapters while recognizing that their content will be featured in the course "Advanced Science Teaching Methods."

National Research Council (1996). *National Science Education Standards.* Washington, DC: National Academy Press. (Available in many bookstores)

AAAS (1993). *Benchmarks for Science Literacy: Project 2061.* New York: Oxford University Press. (Available in many bookstores)

Arkansas Science Content Standards Grades K-12 (2003). Little Rock: Arkansas Department of Education.
http://arkedu.state.ar.us/curriculum/benchmarks.html#Science

2000 National Survey of Science and Mathematics Education (December, 2001).
http://2000survey.horizon-reserach.com

Bayer Facts of Science Education Survey.
http://www.bayerus.com/msms/news/facts.cfm

Strongly Suggested:

APA. (2001). *Publication manual of the American Psychological Association (5th edition).* Washington, DC: American Psychological Association.

In addition, you are expected to read the articles included in the course packet CD ROM.

Organization of Course:

For you and the course to succeed, it is critical that you come to class having thoroughly read and studied the required materials in the readings packet and the text so that you can contribute to an insightful discussion of the topics listed in the syllabus.

Final grades in *Issues, History and Rationale of Science Education* will be based on the following:

• Class Participation (3 pts x 14 class sessions)*	42 points (10%)
• Reaction Papers (30 pts x 4 papers)	120 points (30%)
• Alphabet Soup Curriculum Project (Report & Presentation)	50 points (13%)
• Current Data Research Project	75 points (19%)
• Science Education Web Update Project	50 points (13%)
• Final Examination	60 points (15%)
Total	397 points possible

*Note, this is the maximum value if participation were evaluated for every class period. That may or may not be the case in any given semester.

The Fine Print

Lateness: Working professionals occasionally need to submit an assignment late so to encourage everyone to hand in *all* assignments, I will accept late work. However, in fairness to those who turn assignments in on time there will be a price to pay. All assignments will be reduced by at least one letter grade for each week (or part of a week) of lateness.

The Grade of Incomplete (IN) can be assigned only when work is not completed because of a documented illness or some other emergency occurring *after* the 12th week of the semester. Students must *not* assume that the instructor will agree to the grade of IN. Removal of the "IN" must be instituted by the student, agreed to by the instructor, and reported on the official "Incomplete Completion Form."

Students with Disabilities / Any student requiring accommodations based on a disability is required to register with the Center for Educational Access (CEA) each semester. A letter of verification for approved recommendations can be obtained through CEA. Please be sure I receive the letter early in the semester.

Course Requirements for *Issues, History and Rationale of Science Education***:**

I would like these assignments to be useful to you personally and professionally. Therefore, any time you would like to suggest some version of an assignment slightly different from those listed here, please let me know. For instance, if you work at a science center, you might propose writing a brief history of such sites to fulfill the paper assignment with respect to the "history of science education." Please have this conversation with me *in advance* of the due date!

I) **PAPERS** - Each student will submit short reaction papers (no more than two single spaced typed pages excluding bibliography) (10-12 pt. font size) related to the questions and ideas expressed in the following list. **You must hand in four such papers during the semester with at least one paper from each of the three basic categories – issues, history and rationales**. Include references (in current APA style) to our readings packet and beyond. Each paper is worth 30 points. Please see class schedule for due dates for each of the four papers.

*Issues in Science Education***:**

A) Select a current important issue in science education or science teaching (yes, this will take some familiarization with the literature) and briefly discuss the opposing views with respect to the issue. What stand do you take and why?

B) Discuss some of the ways in which individual student success or science program success in science education can be measured? What methods presently exist for such measurement and what new methods might be needed in your view?

C) What are the future research needs in science education? In other words, what are some questions held by science educators that have not yet been sufficiently investigated?

D) What is your definition of science literacy and how would you determine what things a person should know to be considered scientifically literate at a given age (grade) level?

E) Propose a plan by which those working in science education (particularly those doing research in science teaching and learning) can impact on those teaching science in the nation's schools.

F) Propose a doctoral program (consisting of both science education and non-science education courses and other experiences) in science education by examining at least five existing programs and any other available references. Your job is to list the courses (even if you have to create them) along with a brief description of each course. For this assignment also provide copies of program documents reviewed from other institutions known to be centers of excellence in science education.

History of Science Education:

G) Select a recent important development in science (such as punctuated equilibria announced in the 1970's) and chart its inclusion in textbooks through time. Note: this assignment requires that you have access to a range of texts over time in a particular discipline. You should make sure that you have such access before attempting this option.

H) Within one dimension (this could be a discipline such as biology or a teaching practice such as inquiry) of science, trace its consideration within school programs. Be sure to discuss the trends, emphases, and directions for curricula and teaching practice in this dimension of science?

I) Provide a capsule summary of the history of science education generally (or biology education, for example, in specific) in the United States or some other specific country. Make a proposal for what the next advances or direction may be. Cite evidence to back up your opinion.

J) Discuss how U.S. science instruction has developed (in terms of goals and pedagogical approaches) through time in comparison with at least one other nation.

Rationale for Science Education:

K) Why is science an important element of instruction? What are the central goals and expectations of such instruction? You might like to target a particular grade range (i.e. primary school, museum) or respond more generally.

L) In your discipline (biology, chemistry, physics, etc.), state and defend your choices for the most important fifteen ideas/concepts that must be included in a middle or secondary school course.

M) In elementary science, what do you think are the 15-20 major science related themes that should be included in the K-6 experience? Defend your choices.

N) Suppose you have the opportunity to apply for a mini-grant of $3500 to improve science instruction at your site (school, museum, nature center, etc.). Propose what you might do with that money while providing a rationale for its use.

O) Review a current textbook in some science discipline (or at a particular grade level) and make a recommendation with rationale for what to remove if you were challenged to reduce the length of the book by ten percent.

II) **SCIENCE EDUCATION TIMELINE/GLOSSARY WEB UPDATE PROJECT –** For this assignment you should individually review both the science education timeline and the glossary available at www.scienceeducation.org and do several things. Following your review of both web resources you will contribute at least 8 updates to the timeline and/or the glossary. These updates will be in the form of a significant correction to something that already exists (no more than 3 of these) or an addition to either the timeline or the glossary. Please deliver your updates and additions to me only as an attachment (not a hard copy) that will be ready to upload by the due date. Also, to avoid duplication you should "register" your ideas to me on a first come first reserved basis so the earlier you attempt this assignment (and register) the better.

III) **CURRENT DATA RESEARCH PROJECT** - Using on-line education data sites and/or current data-rich education reports, you will incorporate the most up-to-date statistics and write a three page overview (maximum) of some issue in science education. Examples of appropriate titles include the *"Status of Elementary Science Instruction," "The Education of Science Teachers in Arkansas,"* or *"Science Course Taking Patterns in America's Schools."* This assignment is due at the beginning of Session 14 (when brief reports will be made in class).

IV) **ALPHABET SOUP PROJECT** – During a class session you will make a **brief** (10-12 minutes maximum) presentation of the goals, scope and philosophy of one of the alphabet soup science curriculum projects such as SCIS, S-APA, ESS, etc. Prepare a typed overview of the project for distribution to class members as part of this assignment. Make sure that your overview contains following information (where appropriate) in this format:

1) Title and translation of the acronym
2) Underlying philosophy of the project
3) Goals and Rationale for the project
4) Grade Level(s) targeted
5) History (Developers, dates & funding)
6) Products (availability, current contact)
7) Describe and provide copies of what a unit looks like and how is it used?
8) How are students assessed?
9) Level of acceptance
10) Critique and research findings
11) Summary and conclusions

See Readings #8-9 for assistance with this project. **Note that this assignment will be due as scheduled individually throughout the semester.**

V) **Review and Critique of the Arkansas Science Instructional Standards (40 pts)**

Class Schedule: Issues, History, and Rationale of Science Education (Spring 2009)

Session	Date	Topic
1	JAN 13	What is Science Education? (I)
2	JAN 20	What is Science Education? (II)
3	JAN 27	Science Education: Historical Perspectives **(Rxn Paper #1 due)**
4	FEB 3	Science Education: The Current State of Affairs
5	FEB 10	Science Education: Pursuing the Goals of Science Instruction
6	FEB 17	Is Science Literacy a Rationale for Science Instruction? (**Review of the AR Science Instructional Stds due)**
7	FEB 24	Rationale for & Nature of Science Education Standards **(Assignment II / Web Update Project)**
8	MAR 3	Science Curriculum Projects: Packaging Science Instruction
9	MAR 10	Blended Science Instruction
	MAR 17	NO CLASS / Spring Vacation
10	MAR 24	Leadership in Science Education and Science Instruction **(Rxn Paper #2 due)**
11	MAR 31	Considering Controversies in Science Education
12	APR 7	Nature & Role of Research in Science Education (I) **(Rxn Paper #3 due)**
13	APR 14	Nature & Role of Research in Science Education (II)
	APR 21	NO CLASS / NARST Meeting
14	APR 28	Safety and Other Legalities of Science Instruction **(Assignment III / Data Project due)**
15	May 5	Final Examination (Time to be announced)

SYLLABUS AND READING LIST

Issues, History and Rationale of Science Education

The numbered articles and textbook selections must be read thoroughly *before* you come to class to discuss the topics indicated in the class syllabus. The required articles are included in the readings package and may be supplemented by the additional articles listed below those that are required.

SESSIONS #1/2 Theme: WHAT IS SCIENCE EDUCATION?

Text Assignment: DeBoer / Chapter 11

1/2-1 Hackerman, N. (April 10, 1992). Science education: Who needs it? *Science,* 256, 157.
1/2-2 Woodburn, J. H. (Winter,1993). Yes, Virginia, There is a science educator. *Journal of Science Teacher Education*, p. 30.
1/2-3 Good, R., Herron, D., Lawson, and A. Renner, J. W. (1985). The Domain of Science Education (Rebuttal). *Science Education, 69*(2), 139-141.
1/2-4 National Academy Press (1998). Every Child a Scientist: Achieving Science Literacy for All. Washington, DC: Author.
1/2-5 Ede, A. (July/August, 2000). Has science education become an enemy of science rationality? *Skeptical Inquirer,* 48-51.
1/2-6 Freedman, D. (Fall, 1998). Science education: How curriculum and instruction are evolving. ASCD Curriculum Update Newsletter.
1/2-7 Kober, N. (n.d.) Selections from What we Know about Science Teaching and Learning. Washington, DC: Council for Education Development and Research (p. 3-9).
1/2-8 Busch, H. (2005). Is science education relevant? *Europhysics news*. September/October. 162-67.

SESSION #3 Theme: SCIENCE EDUCATION: HISTORICAL PERSPECTIVES and the NATURE of TEXTS

Text Assignment: DeBoer / Chapters 1-4

Historical Perspectives

3-1 Lacey, A.L. (1966). The foundations of science teaching (pp. 12-19) In *The Foundations of Science Teaching*, Belmont, CA: Wadsworth Publishing Company.

3-2 Bybee, R. W. (1977). The new transformation of science education. *Science Education, 61*(1), 85-97

3-3 Hurd, P. D. (1992). 100 years of science education organizations. *Teachers Clearinghouse for Science and Society Education Newsletter 11*(3).

3-4 Gross, P. R. (2000). Politicizing Science Education. A report from the Thomas B. Fordham Foundation. http://www.edexcellence.net

The Role and Nature of Textbooks in Science Instruction

3-5 Recer, P. (1996). Let's see the sun comes up over there, so that means . . . Los Angeles Times.

3-6 McCann, W. S. (November, 1998). A science teacher's guide to TIMSS. *ERIC Digest*. Columbus, OH ERIC/CSMEE

3-7 Lord, M. (January 22, 2001). Know much about science books? *Newsweek,* P. 50.

3-8 AAAS (Fall, 1999). Heavy texts light on Learning. *2061 Today Newsletter, 9*(2).

3-9 Gould, S. J. (1988). The case of the creeping fox terrier clone. *Natural History, 96*(1), 16-24. Also published in *Bully for Brontosaurus* (1992) pgs. 155-167. New York: W. W. Norton.

SESSION #4 Theme: SCIENCE EDUCATION: THE CURRENT STATE OF AFFAIRS

Text Assignment: DeBoer / Chapter 7 and Bayer Reports in Science Education (Web)

4-1 Tifft, S. (1989). A crisis looms in science. *Time,* (September 11, 1989), pp. 68-70.

4-2 Fisher, A. (1992). Crisis in education: Part I, Science and mathematics. *Popular Science,* (August, 1992).

4-3 Fisher, A. (1992). Crisis in education: Part II, Why Johnny can't do science and math. *Popular Science,* (September, 1992).

4-4 Gibbs, W.W. and Fox, D. (October, 1999). The false crisis in science education. *Scientific American,* pp. 87-93.

4-5 Anon (1996). CCSSO report reveals progress, problems in science education. NSTA Reports December 1995/January 1996.

4-6 Leyden, M. B. (1984). You graduate more criminals than scientists. *The Science Teacher, 51*(3), 26-30.

4-7 National Academy Press (2007/8). Rising above the gathering storm (revised edition). Washington, DC: Author.

4-8 Holliday, W. G. (1999). Questioning the TIMSS. *The Science Teacher, 66*(1), 34-37.

4-9 Hurd, P.D. (1999). Student achievement: Why international comparisons are difficult. *The Science Teacher, 66*(1), 47-49.

4-10 Cozzens, M. B. and Fuhrman, S. H. (2001). Invited Commentary: Lessons from TIMMS-R. *Educational Statistics Quarterly, 3*(1), 14-16.

4-11 Baker, D. R. (2001). Invited Commentary: TIMMS-R. *Educational Statistics Quarterly, 3*(1), 17-18.

4-12 TIMSS (Trends in International Mathematics and Science Study) (2008) Press release (Executive summary) for the 2007. Further information may be found at http://timss.bc.edu/TIMSS2007/release.html

4-13 Selections from the PISA 2007 Report (Program for International Student Assessment). Full report is available at http://nces.ed.gov/pubs2008/2008016.pdf

SESSION #5 Theme: SCIENCE EDUCATION: PURSUING THE GOALS

Text Assignment: None

5-1 Kahl, S. and Harms, N.C. (1981). *Project Synthesis: Purpose, Organization and Procedures*. In N.C. Harms and R. E. Yager (eds.) *What Research Says to the Science Teacher, Vol. 3* (pp 5-11). Washington, DC: National Science Teachers Association.
5-2 Case, S. J. (1988). Developing science education goals. ERIC Document 309083
5-3 Beardsley, T. (1992). Teaching real science. *Scientific American,* 98-108, October.
5-4 AAAS (1990). Science teaching for the 21st century. *Instructor* (March), 35-37.
5-5 Hurd, P. D. (2002). Modernizing Science Education. *Journal of Research in Science Education,* (1), 3-9.
5-6 Koballa, T. R. (1991). Is there substantial agreement on the goals for science instruction? *Research Within Reach: Science Education.* Washington, DC: NSTA.
5-7 Eisner, E. (1985). Five basic orientations to the curriculum. From the book *The Educational Imagination.* pp. 61-86. New York: Macmillan.
5-8 Roberts, D.A. (1982). Developing the concept of 'curriculum emphasis' in science education. Science Education, 66(2), 243-260.
5-9 Anonymous (1989). Impact of Educational Reform on Science Education. ERIC Document 320764
5-10 Selections from the ROSE report (Relevance of Science Education). The full report is available at http://www.ils.uio.no/english/rose/network/countries/uk-england/rose-report-eng.pdf

SESSION #6 Theme: IS SCIENCE LITERACY A RATIONALE FOR SCIENCE INSTRUCTION?

Text Assignment: DeBoer / Chapter 9

6-1 Champagne, A. B. (1989, October). Defining scientific literacy. *Educational Leadership,* 85-86.
6-2 Simpson, P. D. and Anderson, N. D. (1981). What is scientific literacy? From *Science, Students and Schools.* New York: Wiley.
6-3 Hurd, P. DeH. (1990). Historical and philosophical insights on scientific literacy. *Bulletin of the Science, Technology and Society, 10,* 133-136.
6-4 Koballa, T., Kemp, A and Evans, R. (1997). The spectrum of scientific literacy. *The Science Teacher* (October, 1997), 27-31.
6-5 Pool, R. (1991). Science literacy; The enemy is us. *Science, 251*(4), 266-67 (January 18, 1991).
6-6 Culotta, E. (1991). Sciences 20 greatest hits take their lumps. *Science, 251*(10), 1308-09 (March 15, 1991).
6-7 Shamos, M. H. (1984). Scientific literacy: reality or illusion? ERIC Document. (Abstract only)
6-8 Arons, A. B. (1983, Spring) Achieving wider scientific literacy. *Daedalus,* 112-115.
6-9 Hinman, P. L. (March, 1998). Who is scientifically literate, anyway? *Phi Delta Kappan.* p. 540-44.
6-10 DeBoer, G. (2000). Scientific literacy: Another look at its historical and contemporary meanings and its relationships to science education reform. *Journal of Research in Science Teaching, 37*(6), 582-601.
6-11 McEneaney, E. H. (2003). The worldwide cachet of scientific literacy. *Comparative education review, 47*(2), 217-237.

SESSION #7 Theme: SCIENCE EDUCATION STANDARDS / RATIONALES & REALITIES

Text Assignment: None Arkansas K-12 Science Content Standards (Web)

7-1 Williamson, S. E. (1962). A national curriculum in science? *Theory into Practice*, *1*(5), *School Science: Trends and Issues,* pp. 245-252
7-2 Eisner, E. W. (1991). Should America have a national curriculum? *Educational Leadership, 49*(2), 76-81.
7-3 Olson, D. R. (1973). What is worth knowing and what can be taught. (*School Review) American Journal of Education, 82*(1), 27-43.
7-4 Gagnon, P. (1987). Content counts. *American Educator.* Winter. 40-45.
7-5 Selection from Benchmarks for Science Literacy (1993).
7-6 Selection from the National Science Education Standards (1996).
7-7 O'Neil, J. (1993). Can standards make a difference? *Educational Leadership, 50*(5), 4-8.
7-8 Eisner, E. W. (1993). Why standards may not improve schools. *Educational Leadership, 50*(5), 22-23.
7-9 Jarco, I. S. (1995). A critical look at the national science education standards. *Teacher's Clearinghouse, 14*(2). Spring.
7-10 Roeder, J. I. (1995). We have standards and benchmarks -- now what? *Teacher's Clearinghouse, 14*(2). Spring.
7-11 Anderson, S.S. (Spring, 1999). Standards are not enough. Principled Practice in Mathematics and Science Education (3), 2-3.
7-12 Selections from the *New Standards Project* (1995). 1-15, 322-339.

SESSION #8 Theme: PACKAGING SCIENCE INSTRUCTION / CURRICULUM PROJECTS

Text Assignment: DeBoer / Chapter 8

8-1 Lacey, A.L. (1966). Curriculum patterns: Projects of the past In *The Foundations of Science Teaching* (Selections), Belmont, CA: Wadsworth Publishing Company.
8-2 Marcuccio, P. R. (1987). Forty-five years of elementary school science: A guided tour. *Science and Children,* 12-14.
8-3 Shymansky, J. A., et al (1982). How effective were the hands-on programs of yesterday. *Science and Children, 20*(3), 14-15.
8-4 Kyle, W. C. (1991). What became of the curriculum development projects of the 1960's. *Research Within Reach: Science Education*. Washington, DC: NSTA.
8-5 Kyle, W. C., Shymansky, J. A. and Alport, J. M. (1982). Alphabet soup science: A second look at the NSF-funded science curricula. *The Science Teacher* (November) 49-53.
8-6 Kyle, W. C., Bonsetter, R.J. Gadsden, T. and Shymansky, J. A. (1988). What Research Says About Hands-On Science. *Science and Children* (April) 39-40, 52.
8-7 Bredderman, T. (1983). Effects activity-based elementary science on student outcomes. *Review of Educational Research, 53*(4), 499-518.
8-8 Begley, S. (1993). Scratch and sniff science. Newsweek Special Issue. 24-28.
8-9 McComas (n.d.) List of science curriculum programs with an elementary or middle school emphasis.

SESSION #9 Theme: BLENDED SCIENCE INSTRUCTION: RATIONALES & CRITICISMS

Text Assignment: DeBoer / Review Chapter 9

9-1 Hurd, P. D. (1991). Why we must transform science education. *Educational Leadership, 49*(2), 33-35.
9-2 M cComas, W. F. and Wang, H. A. (1997). Blended science instruction: The promise and perils of integrating the science disciplines for instruction. *School Science and Mathematics, 98*(6), 340-348.
9-3 Chisman, D. G. (1990). What is integrated science teaching: Its beginning and its place today? In New Trends in Integrated Science Teaching. Paris: UNESCO. pp. 13-17.
9-4 California Science Framework (1990). The major themes of science (Chapter 2). Sacramento: California Department of Education.
9-5 McDonald, J. and Czerniak, C. (1994). Developing interdisciplinary units: Strategies and examples. *School Science and Mathematics, 94*(1), 5-10.
9-6 Roth, K. J. (1994). Second thoughts about Interdisciplinary studies. *American Educator.* (pp. 44-48) Spring.
9-7 Brophy, J. and Alleman, J. (1991). A caveat: Curriculum integration isn't always a good idea. *Educational Leadership, 49*(2), 66.

Unified/Integrated Approaches

9-8 Yager, R. E., & Lutz, M. V. (1994). Integrated Science: The importance of "how" vs. "what". *School Science & Mathematics.*
9-9 Fogarty, A. (1991). Ten ways to integrate the curriculum. *Educational Leadership, 49*(1), 61-65.

Coordinated Approaches (SS&C)

9-10 Science for All Americans: Summary (1989). Project 2061. Washington, DC: American Association for the Advancement of Science
9-11 Anon (1993). What is the difference between Project 2061 and SS and C? *Teacher's Clearinghouse for Science and Society Education Newsletter*, (Winter).

Science, Technology and Society (S/T/S)

9-12 National Science Teachers Association (1990). An NSTA Position Statement on Science/ technology/ society: A new effort for providing appropriate science for all. Washington, DC: Author.
9-13 Yager, R. E. (1996). History of science/technology/society as reform in the United States. (pp. 3-15). In R. E. Yager (Ed). Science/Technology/Society as reform in science education. Albany, NY: State University of New York Press.
9-14 Jarco, I. S. (1985). S/T/S in practice: Five ways to make it work. *Curriculum Review,* 17-20.

SESSION #10 Theme: LEADERSHIP IN SCIENCE EDUCATION AND SCIENCE INSTRUCTION

Text Assignment: None

Educational Leadership: The Big Picture

10-1 Knapp, M. S., Copland, M. A. and Talbert, J. E. (2003, February). Leading for Learning: Reflective Tools for School and District Leaders. University of Washington: Center for the Study of Teaching and Policy.

Teacher Education

10-2 Darling-Hammond, L., Youngs, P. (2002). Defining "highly qualified teachers": What Does "Scientifically Based Research" Actually Tell Us? *Educational Researcher, 31*(9), 13-23.
10-3 Andersen, H. O. (2000). Emerging Certifications and Teacher Preparation. *School Science and Mathematics, 100*(6), 298-303.

Professional Development

10-4 Guskey, T. R. (2003). What makes professional development effective? *Phi Delta Kappan, 84*(10), 748-750.
10-5 Kelleher, J. (2003). A model for assessment-driven professional development. *Phi Delta Kappan, 84*(10), 751-756.
10-6 Howe, A. C. and Stubbs, H. S. (2003). From Science Teacher to Teacher Leader: Leadership Development as Meaning Making in a Community of Practice (Selection only). *Science Education, 87*(2), 281-289.

SESSIONS #11 Theme: CONSIDERING CONTROVERSIES IN SCIENCE INSTRUCTION

Text Assignment: None

Issues of Inclusion and Equity

11-1 Tobias, S. (1990). *They're Not Dumb, They're Different: Stalking the Second Tier* (Selections). Tucson, AZ: Research Corporation.

11-2 Various Authors (1993). Trying to change the face of science (A special report from *Science,* 262 (November).

11-3 Kober, N. (n.d.) Selections from what we know about science teaching and learning. What special problems do girls, minority students and children with disabilities face in science and what can teachers and students do? Washington, DC: Council for Education Development and Research.

11-4 Peltz, W. H. (1990). Can girls plus science minus stereotypes equal success. *The Science Teacher,* 45-49, December.

11-5 Ripley, A. (2005). Who says a woman can't be Einstein? Science, 51-60.

11-5 Fraser-Abder, P. (2001). Preparing Science Teachers for Culturally Diverse Classrooms. Journal of Science Teacher Education, 12(2), 123-131.

11-6 Klotz, I. M. (1993). Multicultural perspectives in science education: One prescription for failure. *Phi Delta Kappan,* 266-269, November.

Evolution & Creationism: What Counts as Content in Science Instruction?

11-7 NABT (1996). Teaching evolution: A position statement. *The American Biology Teacher, 58*(1)

11-8 Wallis, C. (2005). The evolution wars. *Time*, August 15, 2005.

11-9 Edwords, F. (1983). Is it really fair to give evolution equal time? In *Scientists Confront Creationism*. L. R. Godfrey (Ed.) (pp. 304-316.)

Dissection: The Unkindest Cut?

11-10 Kleinhuizen, J. (1991, April 30). Dissection cut back amid student dissent. *USA Today*.

11-11 McInerney, J. D. (1993). Animals in education: Are we prisoners of false sentiment? *American Biology Teacher, 55*(5), 276-280.

SESSION #12 Theme: RESEARCH IN SCIENCE EDUCATION: THE EMPIRICAL BASIS (I)

Text Assignment: None

12-1 Wright, E. L. (1993). The irrelevancy of science education research: Perception or reality? *National Association for Research in Science Teaching Newsletter, 35(*1).
12-2 Linn, M. C. (1987). Establishing a research base for science education: Challenges, trends, and recommendations. *Journal of Research in Science Teaching, 24*(3), 191-216.
12-3 Donmoyer, R. (1992). Rethinking the form and function of scientific research in science education. National Center for Science Teaching and Learning. Monograph #5.
12-4 Feldman, A. and Atkin, J. M. (1993). Research in science education in the USA. *Journal of Curriculum Studies, 25*(3), 281-289.
12-5 Jegede, O., Kyle, W.C. and Okebukola, P. (1999). How relevant is science education research? Presented at the National Association for Research in Science Teaching. Boston, MA: March 1999.

SESSION #13 Theme: RESEARCH IN SCIENCE EDUCATION: THE EMPIRICAL BASIS (II)

Text Assignment: None

12-1 AERA (2007). AERA Research Points: Science Education Makes Sense. Summer 2007, 5(1), 1-4.
12-2 Tai, R.H., Liu, C.Q, Maltese, A.V. and Fan, X. (2007). Planning early for careers in science. *Science, 312*, 1143-1144.
12-3 Casonova, U. (1989, January). Research and practice: We can integrate them. *NEA Today.*

SESSION #14 Theme: SAFTEY and other LEGAL ISSUES IN SCIENCE TEACHING

Text Assignment: None

14-1 NSTA (2000). The National Science Teachers Association statement on Laboratory Safety. Arlington, VA: Author.
14-2 Selections from the Flinn Scientific Company catalog on Safety in the Laboratory
14-3 NRC (2006). Selections from America's Lab Report: Investigations into High School Science (pgs 182-189). Washington, DC: Author.

SESSION #15 FINAL EXAMINATION

The final will be held in our classroom or as delivered as an e-mail attachment. The starting and ending time may differ from the traditional class time per University policy.