COLLEGE OF EDUCATION and HEALTH PROFESSIONS
Department of Curriculum and Instruction

Course Number: CIED 6343
Title: *Advanced Science Teaching Methods*
Semester: Spring 2008
Day/Time: Tuesdays from 5-8pm
Room: PEAH
Credits: 3
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Course Description: This course is designed for educators who have had some previous instruction in the methods of science teaching and/or had some prior science teaching experience either in a formal school or informal science teaching environment. This class differs from introductory methods classes because it is designed to build on prior teaching experiences. We will reflect on practice from practical and theoretical perspectives to evaluate and fine-tune science teaching skills. Participants will gain new or renewed perspectives with respect to their teaching ability while engaging in discussions and activities designed to assist others in professional growth as science instructors.

Course Objectives:

During *Advanced Science Teaching Methods*, we will examine:

- personal goals, strategies and rationales for high quality science teaching;
- modes and rationales for the quantitative and qualitative exploration and evaluation of science teaching;
- the special challenges and advantages of informal science learning;
- models of effective science teaching and learning;
- constructivism and related conceptual change teaching strategies;
- the use of discrepant events and related plans for inquiry teaching;
- the laboratory as a unique teaching venue;
- educational technology in the science classroom and
- issues and implications of science curriculum design.

Required Text: In addition to the required readings, the required text is Donovan, M.S. and J.D. Bransford (2005) (eds.) *How Students Learn: Science in the Classroom*. Washington, DC: National Academies Press. You should also consider *Looking in Classrooms* by Good and Brophy (New York: Harper and Row) which is a good general treatise with applications for science instruction.

Text Note: Please read the following sections in the Donovan and Bransford text (the titles are mine). *"How People Learn"* (pgs. 1-23); *"Scientific Inquiry and Conceptual Change"* (pgs. 399-415), *"Teaching Elementary Science with Guided Inquiry and Cycles of Investigation"* (pgs. 421-469), *"Putting it all Together"* (pgs. 569-589). If you have time, you might look at *"Guided Inquiry, Part II"* (pgs. 475-513) and *"Model Based Inquiry"* (pgs. 515-561).

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

Class Schedule: Advanced Science Teaching Methods (Spring 2008)

Session	Date	Theme
1	January 15	Setting Goals & Considering Science Teachers' Knowledge (I)
2	January 22	Setting Goals & Considering Science Teachers' Knowledge (II)
3	January 29	Examining and Enhancing Science Instruction (I)
4	February 5	Examining and Enhancing Science Instruction (II)
5	February 12	Educational Psychology in the Service of Science Instruction
6	February 19	Constructivism & Science Teaching: Theoretical Perspectives
7	February 26	Constructivism & Science Teaching: Conceptual Change Models
8	March 4	Science Instruction in Informal (Non-school) Environments (I)
9	March 11	Science Instruction in Informal (Non-school) Environments (II)
	March 18	SPRING VACATION (NO CLASS)
10	March 25	Inquiry Instruction – Rationales and Strategies
	April 1	NARST CONFERENCE (NO CLASS)
11	April 8	Inquiry Instruction – Assessment & Laboratory Facility Design
12	April 15	Inquiry Instruction – Practical Issues: Teaching in the Laboratory
13	April 22	Technology in the Service of Science Instruction
14	April 29	Issues in Science Curriculum Design
15	May 6	Final Examination (TBA)

Your grade in *Advanced Science Teaching Methods* will be based on the following:

1. Discrepant Event Presentation with Lesson Plans (Individual Project)

Find, modify or develop a discrepant event and present it to the class in 5-8 minutes. This presentation should be accompanied by a one page (front/ back is OK) handout with the following sections: a) overview/introduction, b) grade level targeted, c) time constraints and issues, d) necessary materials, e) discussion of where this would fit within the science curriculum, f) the nature of the discrepancy and a discussion of what is happening from a scientific perspective.

Please provide a copy of the handout to each class member at the conclusion of your presentation. Note, for help in finding discrepant events you should consult Tik Liem's book (Invitations to Science Inquiry), visit the following web sites, and/or "google" discrepant events:

http://www.nipissingu.ca/education/geraldl/sciencegeneral/discrepant_events.htm
http://tiger.coe.missouri.edu/~pgermann/DiscEvent/
http://www.tcnj.edu/~minogue/Course%20Materials/Discrepant%20Events_activity.pdf

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2. Rational Statements with Reflection (Individual Project)

State 10 reasons (rationales) in descending order of importance that you hold for science instruction (for a particular audience such as elementary school age children). In other words, what 10 justifications for teaching science would you propose if asked to defend why we teach science? After you have crafted your rationales, state what the students will be doing and what the instructional setting would look like to support such a justification for science instruction and what your role as a teacher would be in support of that goal.

The following issues will be considered in evaluating this assignment:

- Worthiness and appropriateness of the goals themselves.
- The relationship of what you write about what the classroom should look like, what the students would be doing and what your role would be to each goal. (For instance, if you say that you want students to become independent science learners, it would be inappropriate for you to dispense information through lectures every class period).
- General organization of the paper (is it easy to follow what you are saying?)
- Include some information about how you would assess if you are meeting the goal
- Avoid including multiple goals in one statement
- I will make some attempt to view each paper against the others in terms of time spent, clarity, sophistication and appropriateness of goals, etc.

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3. Mr. Wizard's Teacher to Teacher Project (Individual)

You will be given a videotape (sorry no DVDs) of an episode from the series "Teacher to Teacher" produced several years ago by the Mr. Wizard Institute (the forerunner of Bill Nye the Science Guy). These tapes feature expert teachers engaged in instruction at various grade levels (see Appendix A for the list). For this assignment you are to review the tape and do the following: 1) generally review the presentation and provide an abstract of what is occurring in each section, 2) using a counter, reference the most useful/illustrative elements of the tape and 3) correlate those elements with illustrations of important teaching techniques. When we are done we will have a matrix that shows, for instance, all of the instances of inquiry or high quality questioning or the use of wait time and its impact, etc.

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4. **Personal Lesson Evaluation and Critique (Individual Project)**

For this assignment you will video record or audiotape yourself (preferably) teaching a lesson of at least 40 minutes in length. You will then choose something significant to examine (wait time for example) and apply a valid and reliable way to measure that behavior or interaction and write up a "lab report" of your findings.

The following issues will be considered primarily (but not exclusively) in assigning a grade for this

assignment choice:

- inclusion of an audio or video recording of the subject
- the mode, target, appropriateness and completeness of the data analysis
- the presentation and evaluation of the data
- a subjective view of how your product compares with others
- the overall impact of your written presentation

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5. Science Teaching Research, Evaluation or Design Project (Individual Project)

Here you will choose ONE of the following options and conduct a study and report your results in much the way that you did for the previous assignment. Details for the completion of all of these options will be provided in class.

A) Series of Lesson Plans (>3) Structured to Reflect one of the Conceptual Change Instructional Models
B) Presentation of the Results of a Series of Focused Misconception Interviews (with commentary and conclusions) either of students or of teachers
C) Presentation of the Results of a Series of Piagetian Interviews (with commentary and conclusions) of students of a particular age or across an age range of students.

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6. Final Project: Report of Field Research in the Informal Science Environment (Group Project)

This assignment is an opportunity for you and a partner to investigate what happens (or doesn't happen) in an informal science learning environment by doing ONE of the following:

Option 6A (Investigation of Learning in an Informal Environment):

a) Ask an interesting question that could be addressed by exploring an informal science learning environment such as a zoo, aquarium, botanical garden, science center or museum. Such questions might include; how long do people spend looking at or interacting with particular exhibits or types of exhibits, what expectations do people have when entering/leaving the informal site, etc?

b) Choose a research environment that will allow you to answer your question.

c) Design a method (survey, interviews, observations, etc.) that will allow you to address your question(s).

d) Spend an appropriate amount of time in the environment conducting your study so that you have a reasonable impression of what the answer to the question might be. I am not expecting that you will turn this into a thesis, but you must investigate long enough and provide enough data to have a sense of the answer.

e) Write up your results in an appropriate fashion. As a guide, past projects of this type have been 8-12 pages in length.

Option 6B (Investigation of the Impact of Aspects of an Informal Environment):

> Visit an informal science learning environment (ISLE)(such as a zoo, aquarium, botanical garden, science center or museum) and focus on a suite of related exhibits for an extended period of time. Given you what you know about science learning, provide a critique of what that exhibit suite is doing well and what it might be doing better. This is a chance to provide feedback to the ISLE without much regard to money or other such restraints.

Please note, for both of these assignments it is my hope that we will all go together to the *Middle America Science Center* in Hot Springs, Arkansas. Tentatively, we would leave late in the day on Friday April 18th visit the museum for most of the day on April 19th and arrive back in Fayetteville on April 19th.

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7. Participation (3 pts per class session attended) (3pts x 14 sessions = 42 pts)

Assessment Overview and Due Dates

Assignment	Due Date	Value	%
1. Discrepant Event w/Lesson Plan	Individually Scheduled	30 pts	%
2. Rationales for Teaching Science	Session 2	50 pts	%
3. Mr. Wizard's Teacher to Teacher	Session 5	100 pts	%
4. Personal Science Lesson Critique	Session 8	125 pts	%
5. Science Teaching Research Project	Session 10	100 pts	%
6. Final Project: Informal Science Learning Field Research	Session 14	135 pts	%
7. Attendance and Class Participation	On-going	42 pts	%
	TOTAL	572 pts	100%

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 Disability Services and Programs (DSP) office each semester. A letter of verification for approved recommendations can be obtained through DSP. Please be sure the letter is delivered to me as early in the semester as possible.

ADVANCED SCIENCE TEACHING METHODS - READING LIST

The following articles are required and should be read thoroughly before discussion of the related topics as indicated in the class syllabus. All of these articles, handouts and related materials are available from the instructor on a CD ROM.

Useful Preliminary Materials (included in readings)

A) Model Teaching Unit Plan (McComas)
B) Writing a Lesson Plan (McComas)
C) Hewett, E. C. (1884). A treatise on pedagogy (selection).
D) Liem, T. L (n.d.). Invitations to Science Inquiry (2nd edition).
An example of a discrepant event (pg. 383).

Useful Websites (for you to pursue on your own)

A) The Center for Inquiry Based Learning (CIBL) at Duke University
http://www.biology.duke.edu/cibl/index.htm
B) Nation Center for Case Study Teaching in Science
http://ublib.buffalo.edu/libraries/projects/cases/case.html

SESSIONS # 1& 2 Setting Goals and Considering Science Teachers' Knowledge

1-1 National Commission on Teaching and America's Future (1996). What Matters Most: Teaching for America's Future (Summary Report). New York: NY.
1-2 Berliner, D.C. (1986). In pursuit of the expert pedagogue. *Educational Researcher, 15*(7), 5-13.
1-3 Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*,(2), 4-14
1-4 Yeany, R. H. (1991). Teachers' knowledge bases: What are they? How do we affect them? SAETS Science Education Series Monograph 1.
1-5 Wulf, S. (1997). A new lesson plan. *Time, 149*(21), 75-78.

1-6 California Science Project (n.d.) Visualizing the Future in Science Education.
1-7 Porlan, R. and del Pozo, R. M (2004). The conceptions of in-service and prospective primary school teachers about the teaching and learning of science. Journal of Science Teacher Education, 15(1), 39-62.
1-8 Friedrichsen, P. M. & Dana, T. M. (2003). Using a card-sorting task to elicit and clarify science teaching orientations.

SESSION #3 Examining and Enhancing Science Instruction (Part I)

3-1 McComas, W.F. (n.d.). Interaction coding and analysis as an evaluation and research tool. Unpublished manuscript.
3-2 Tuckman, B.W. (1995, Winter). Assessing effective teaching. *Peabody Journal of Education*, 127-138.
3-3 Flanders, N.A. (n.d.) Categories of the Flander's system of interaction analysis.
3-4 Abraham, M.R. and Schlitt, D.M. (1973). Verbal interaction: A means of self evaluation. *School Science and Mathematics, 73*, 678-686. Including SATIC categories and coding sheets.
3-5 Good, T.L. and Brophy, J. (1991). Selection from "Looking into classrooms." New York: Harper Collins. p. 148-152.

SESSION #4 Enhancing Science Teaching (Part II)

4-1 Blosser, P. E. (1991). How to Ask the Right Questions. Washington, DC: National Science Teachers Association.
4-2 McComas, W. F. (n.d.) Questioning skills (compilation of comments from Good and Brophy "Teacher-Student Relationships: Causes and Consequences," and Dillon "Asking Better Questions"
4-3 Rowe, M. B. (1986). Wait time: Slowing down may be a way of speeding up! *Journal of Teacher Education* (Jan-Feb) 43-50.
4-4 Elstgeest, J. (1985). The right question at the right time. From W. Harlen (Ed.) *Primary Science: Taking the Plunge*, p. 36-45. Heinemann Educational Books.
4-5 Treagust, D. F. Harrison, A.G. and Venville, G. J. (1998). Teaching science effectively with analogies: An approach for preservice and inservice teacher education. *Journal of Science Teacher Dducation, 9*(2), 85-101.
4-6 Morgan, W. R. (1995, March/April). Critical Thinking – What Does it Mean? *Journal of College Science Teaching*. 336-340

SESSION #5 *Educational and Cognitive Psychology in the Service of Science Instruction*

Text Reading: *"How People Learn" (pgs. 1-23)*

5-1 Various authors (n.d.) Taxonomies and Instructional Objectives in Educational Psychology.
5-2 General Behavioral Objectives in the Cognitive Domain
5-3 Woolfolk, A. E. (1987). Guidelines for teaching concrete and formal operational children. From *Educational Psychology, 3rd edition*. Englewood Cliffs, NJ: Prentice Hall.
5-4 Phillips, D. G. (n.d.). *Structures of Thinking: Concrete Operations* (2nd Edition). Dubuque, IA: Kendall Hunt Publishing Company.
5-5 McCormack, A. (1970). Piagetian task administration instruments. *Science & Children*, 16-17.
5-6 Howe, A.C. (1996). Development of science concepts within a Vgotskian framework. *Science Education, 80*(1), 35-51.

5-7 Cleminson, A. (1990). Establishing an epistemological base for science teaching in the light of contemporary notions of the nature of science and of how children learn science. *Journal of Research in Science Teaching, 27*(5), 429-445.
5-8 Lowrey, L. (1998). How new science curriculums reflect brain research. *Educational Leadership* 56(3), 26-30.
5-9 Lowrey, L. (1992). The biological basis of thinking and learning. Manuscript associated with the FOSS Curriculum Project.

SESSION #6 **Constructivism and Science Teaching: Theoretical Perspectives**

Text Reading: *"Scientific Inquiry and Conceptual Change"* **(pgs. 399-415)**

6-1 Lorsbach, A. and Tobin, K. (1992). Constructivism as a referent for science teaching. NARST Research Matters Newsletter. (September)
6-2 Wheatley, J. H. (1991). Constructivist perspectives on science and mathematics learning. *Science Education, 75*(1), 9-21.
6-3 von Glasersfeld, E. (1989). Cognition, construction of knowledge and teaching. National Science Foundation. *Synthese* (80), 121-140.
6-4 Saunders, W. L. (1992). The constructivist perspective: Implications and teaching strategies for science. *School Science and Mathematics, 92*(3), 136-41.
6-5 Appleton, K. (1993). Using theory to guide practice: teaching science from a constructivist perspective. *School Science and Mathematics, 93*(5).
6-6 Stepans, J. (1994). Misconceptions and conceptual change (pp. 1-9) Selection from the book "*Targeting Students' Science Misconceptions*." Riverview, FL: Idea Factory.
6-7 Gil-Perez, D. and Carrascosa, J. (1990). What to do about science misconceptions. *Science Education, 74*(5), 531-40.
6-8 Yager, R. E. (1991). The constructivist learning model. *The Science Teacher, 58*(6), 52-57.

SESSION #7 Constructivism and Science Teaching: Conceptual Change Models

Text Reading: *"Teaching Elementary Science with Guided Inquiry and Cycles of Investigation"* **(pgs. 421-469)**

7-1 Osborne, R.J. and Wittrock, M.C. (1985). The generative learning model and its implications for science education. *Studies in Science Education, 12*(1), 59-87.
7-2 Lawson, A. E., Abraham, M. R. and Renner, J. W. (1989). A theory of instruction: Using the learning cycle (selection). NARST Monograph #1.
7-3 Anon (n.d.) The steps of the learning cycle.
7-4 Barman, C. R. (1989, Feb). The learning cycle: Making it work. *Science Scope*, 28, 30.
7-5 Watson, B and Konicek, R. (1990). Teaching for conceptual change: Confronting childrens' experience. *Phi Delta Kappan, 71*(9), 680-85.
7-6 Beeth, M.E. (1998). Facilitating conceptual change learning: The need for teachers to support metacognition. *Journal of science teacher education, 9*(1), 49-61.
7-7 Beeth, M. E. and Hewson, P. W. (1999). Learning goals in an exemplary science teacher's practice. Cognitive and social factors in teaching for conceptual change. *Science Education, 83*(6), 738-60.
7-8 McComas, W. F. (1996). Constructivist and Traditional Classes Compared. Unpublished MS.
7-9 McComas, W. F. (1996). The ED^{3}U Model: Teaching for Conceptual Change. Unpublished MS.

SESSION #8 *Informal Science Instruction (I)*

8-1 Bitgood, S. (1988). A comparison of formal and informal learning. Technical report 88-10. Center for Social Design. Jacksonville, AL: Jacksonville State University.
8-2 Bitgood, S. and Thompson, D. Visitor learning in science museums, zoos and aquariums: A review. Center for Social Design. Jacksonville, AL: Jacksonville State University.
8-3 Csikszentimhayi, M and Hermanson, K. (1995). Intrinsic motivation in museum learning. *Museum News*, 34-61.
8-4 Dierking, L.D. and Falk, J. H. (1994). Family behavior and learning in informal science settings: A review of the research. *Science Education, 78*(1), 57-72.
8-5 Ramey-Gassert, L. and Walberg, H. J. (1994). Reexamining connections: Museums as science learning environments. Science Education, 78(4), 345-363.
8-6 Boyd, W. L. (1993). Museums as centers of learning. *Teachers College Record, 94*(4), 761-770.
8-7 Semper, R. J. (1990). Science museums as environments for learning. *Physics Today,* 2-8.
8-8 Falk, J.H., Dierking, L.D. & Adams, M. (2006). Living in a learning society: Museums and free-choice learning. In: S.J. Macdonald (ed.) Blackwell Companion to Museum Studies. London: Blackwell Publishing.

SESSION #9 Informal Science Instruction (II)

9-1 Patterson, D. and Bitgood, S. (1987). Exhibit design with the visitor in mind. Report 87-40A. Center for Social Design. Jacksonville, AL: Jacksonville State University.
9-2 McComas, W. F. and Lafferty, S. K. (1996). Constructivist learning theory and informal education. Unpublished manuscript.
9-3 Anon (n.d.) Two diagrams of museum exhibit plans. American Museum of Natural History (New York, NY) and the Museum of Westward Expansion (St. Louis, MO).

SESSION #10 Inquiry Instruction: Rationales and Strategies

Text Reading (Optional): *"Guided Inquiry, Pt II"* (pgs. 475-513) & *"Model Based Inquiry"* (pgs. 515-61)

10-1 Hawkins, D. (February, 1965). Messing about in science. *Science and Children*.
10-2 Roth, K. J. (1989, Winter). Science education: It's not enough to do or relate. *American Educator*, 16-22 and 46, 48.
10-3 Anon (1995, March/April). Inquiry based science: What does it look like? *Teachers' lab*, 13-14.
10-4 Selections from *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning* (2000). Washington, DC: National Academy Press
10-5 Lumpe, A.T. and Oliver, J. S. (1993). Dimensions of hands-on science. *American Biology Teacher, 53*(6), 345-348.
10-5 Costenson, K. and Lawson, A. E. (1986). Why isn't inquiry used in more classrooms? *American Biology Teacher, 48*(3), 150-158.
10-7 McComas, W. F. (n.d.) An Introduction to the Suchman Inquiry Model.
10-8 Lott, G. W. (1983). The effect of inquiry teaching and advance organizers upon student outcomes in science education. *Journal of Research in Science Teaching, 20*(5), 437-451.

SESSION #11 Inquiry Instruction: Practical Issues of Teaching in the Laboratory

11-1 Singer, S. R., Hilton, M.L. and Schweirigruber, H. A. (eds.) (2005). America's Lab Report: Investigations in High School Science. Washington, DC: National Academies Press (2005).

11-2 National Science Teachers Association (2007). An NSTA position statement: Laboratory science. Washington, DC: Author.
11-3 National Association of Biology Teachers (2005). Position statement: The role of the laboratory in the biology classroom. Reston, VA: Author.
11-4 McComas, W. F. (1997). An ecological perspective of the laboratory teaching environment. *Science Education International*, 8(2), 12-16.
11-5 McComas, W. F. (Spring, 1997). The nature of the laboratory experience: A guide for describing, classifying and enhancing hands-on activities. *CA Science Teachers Association Journal*, pp. 6-9.
11-6 Blosser, P. E. The role of the laboratory in science teaching. ED 273 490
11-7 Pickering, M. (1980). "Are lab courses a waste of time?" From the column "Point of View" *The Chronicle of Higher Education* (p. 80). February 19, 1980.
11-8 Pickering, M. (1985). Lab is a puzzle, not an illustration. *Journal of Chemical Education, 62*(10), 874-875.
11-9 McComas. W. F. (n.d.) Enhancing the laboratory experience: A checklist to improve instruction. Unpublished document.
11-10 Leonard, W. H. (1980). Using the extended discretion approach in biology laboratory investigations. *The American Biology Teacher, 42*(7), 338-348.
11-11 Leonard, W. H. (1996). A recipe for uncookbooking laboratory investigations. *Journal of College Science Teaching, 21*(2), 84-87.
11-12 Millar, R. (1987). Towards a role for experiment in the science teaching laboratory. *Studies in Science Education*, 14, 109-118.

SESSION #12 Inquiry - Assessment and the Design of Laboratory Facilities

Text Reading: *"Putting it all Together" (pgs. 569-589)*

12-1 Penick, J. and Shymansky, J. (1978). Coding Worksheet: Science Laboratory Interaction Categories (SLIC).
12-2 Stensvold, M.S. and Wilson, J. T. (1993). A method of designing practical examinations to match what is taught in laboratory activities. *School science and mathematics, 93*(5), 250-252.
12-3 McComas, W. F. (1991). Case Study 5: Bryan Walker/Chemistry. From The Nature of Exemplary Practice in Secondary School Laboratory Instruction. Unpublished Dissertation, University of Iowa, Iowa City, IA.
12-4 Doran, R. L., J. Boormand, F. Chan and N. Hejaily (1993). Authentic assessment: An instrument for consistency. *The Science Teacher*, 60(6), 36-41.
12-5 Giddings, G., Hofstein, A., Lunetta, V. (1991). Assessment and evaluation in the science lab. In *Practical Science*. B. Woolnough (ed.) Pp. 167-77. Bristol, PA: Open University Press.

SESSION #13 Technology in the Service of Science Instruction

13-1 Rodrigues, S. (1997). Fitness for purpose: A glimpse at when, why, and how to use information technology in science lessons. *Australian Science Teachers, Journal*, *43*(2), 38-39.
13-2 Devitt, T. (1997). Six reasons to infuse science with technology. *Electronic Learning, 16*(5), 40-44,46,61.
13-3 McGrath, B. (1998). Partners in learning: Twelve ways technology changes the teacher-student relationship. *T.H.E. Journal, 25*(9), 58-61.

13-4 Means, B. and Olson, K. (1994). The link between technology and authentic learning.

Educational Leadership, 51(7), 15-18.

13-5 Frost, R. (1997). Computer software for science teaching -- choosing and using. *School Science Review, 79*(287), 19-24.

13-6 Novak, A. M., Gleason, C., Mahoney, J. and Krajcik, J. S. (2002). Inquiry through portable technology. Science Scope (Nov/Dec), p. 18-21.

13-7 Various Sources (1999). Education, technology, and the Internet: Possibilities. Unpublished document.

SESSION #14 Issues in Science Curriculum Design

14-1 McComas, W. F. (1996). The nature of the curriculum: Definitions and considerations. Unpublished manuscript.

14-2 Anonymous (n.d.) Designing a science curriculum. Eric Document 108 943

14-3 Anonymous (n.d.) Curriculum ideologies. From Science Curriculum Resources Handbook. Milwood, KS: Kraus International Publishers.

14-4 Anonymous (n.d.) Influences on curriculum design. (Chart)

SESSION #15 Final Examination. The final will be held in our classroom or delivered as an e-mail attachment. Details to be announced.

Appendix A

Titles of the Mr. Wizard / Teacher-to-Teacher Videotapes

Series 2: Batteries and Bulbs (Grade 5 and 6)

Series 3: Balloons & Gases (Grade 6)

Series 4: Part 1: Structures (Grade 6)

Series 4: Part 2: Structures (Grade 6)

Series 5: In-digestion (Grade 5)

Series 6: Pushes and Pulls (Grade 1)

Series 7: Floating & Sinking (Grade 3/4)

Series 8: Part 1: Air and Weather (Grade 2)

Series 8: Part 2: Air and Weather (Grade 2)

Series 9: Wood (Kindergarten)