APPENDIX

TEACHING SCIENCE IN THE ELEMENTARY/MIDDLE SCHOOL

**Spring 2017**

**Section 2: T 8:45 AM-11:15 AM**

Course Description

This course considers different teaching models, metacognitive tools, inquiry structures, assessment approaches, curriculum design, use of computer technology in elementary and middle school science instruction, and state and national science education standards. Issues of safety and accessibility are addressed as a part of curriculum planning for the science classroom.

# Goals

The following four general goals for pre-service teachers drive the curricular approach, organization, and content decisions for the course:

1. Grow in understanding the vital role science and engineering education can play in the development of children,
2. Gain confidence in self as an agent of science and engineering education capable of researching and teaching science and engineering,
3. Build knowledge of children’s ideas about science and the natural world, their thinking processes, and their attitudes toward science, engineering and design of solutions, and
4. Begin to view the instructional processes of science and engineering education as a dynamic, reflective investigation into the process of shared learning.

## Intended Learning Outcomes

In concert with these goals, the pre-service elementary/middle level teachers will be expected to

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| **Objectives** |
| Demonstrate facility using concept maps as planning, assessment, and investigation-structuring metacognitive tools. |
| Identify and use different types of investigations and key investigation components. |
| Work effectively with colleagues in all aspects of the classroom: observation; investigation of students’ prior knowledge; unit planning and implementation; reflective analysis and assessment of the unit; and presentation of the unit to the class. |
| Apply an understanding of the NGSS Science and Engineering Practices, Crosscutting Concepts, Disciplinary Core Ideas, and Nature of Science to effective lesson plan development |
| Describe the theory of conceptual change and utilize this knowledge in planning, implementation, and analysis of science instruction for students in the grades of their intended licensure. |
| Describe and distinguish between at least two instructional models and direct and indirect instructional sequences, recognize that a variety of different instructional models may use direct and/or indirect instructional sequences, identify elements of these instructional models through systematic observation in the classroom of a consulting teacher. |
| Integrate children’s literature and informational text as instructional science tools. |
| Identify appropriate sources of information related to current safety regulations, practices in the science classroom, and storage room. |
| Locate and be knowledgeable about current resources regulating the care and treatment of animals in the classroom. |
| Plan the use of varied modes of assessment in the science classroom. |

# Evaluation

The final evaluation of the course performance will be a weighted combination of the following elements:

20% **Attendance & Lesson Plan Discussion with Instructor each week**

20% Online Quizzes

10% Classroom Observations/Reflection-Due Friday after each class

20% Lesson Plans (Individual Grade even if planned cooperatively)-Due Thursday before teaching

20% Formative Assessment Probe Analysis-due March 7

10% Final Exam

**Attendance & Participation**

Course **attendance is important** and essential to maximizing learning opportunities for all members of the course. Twenty percent of the course grade will be based on attendance and participation in the course activities, including incidental written work, teaching in classrooms, on-line class tasks, and general class discussions. For this methods course integrated into Rolling Hills, a part of each week’s participation is being prepared to discuss with your instructor your upcoming lesson plan in an individual or group conference.

For all course sessions, percentage points will be deducted for absences (**5% for the first absence, 3% for each thereafter**), late arrivals and/or early departures (1% for the second and each thereafter). It is the **student’s responsibility** to inform the instructor, group members, and classroom teacher (if applicable) in advance of an absence and if arriving late, it is necessary to check in with the instructor immediately after class to adjust the record. It is also the student's responsibility to complete preparation tasks and in class assignments **for all absences.**

**Reading Assigned Materials**

Reading of course materials is an important method of learning about science teaching methods. Readings may be discussed in class. Online quizzes will be used to check basic understanding of the material. Each quiz will allow 2 attempts. The highest score will be counted. Quiz questions come from a random bank of questions, so please note that the second attempt will likely have different questions from the first. Quizzes are due at midnight on the Monday before the class they are assigned (EXCEPTION: for fully online class weeks, those quizzes are not due until the following Monday so that they can be done in place of that face-to-face class period).

**Classroom Reflections**

A one page reflection is due each week that you are in a classroom observing or helping. It should include a description of what occurred in the classroom and reflection upon how the teaching methods you or the teacher uses show one of the following: the use of inquiry-based teaching methods, the use of one of the strategies from our textbook, or three-dimensional learning described by the NGSS. Reflections are due by the Friday following the class period.

**Lesson Plans**

Lesson plans are required each week that you are in the classroom EXCEPT for the first class period. Your instructor will refer you to the rubric for lesson plans for the following week. Different elements will be included in your grade each week. They are to be submitted to the Dropbox AND emailed to your cooperating teacher (and CC’ed to your instructor) by Thursday at midnight before you teach that lesson. Cooperatively planned/taught lessons will be graded individually, so each person should either submit their own plan (perhaps if doing stations or teaching separate groups) or with color-coding showing the contribution of each person if using more integrated methods of co-teaching.

**Grading Scale**

The following grading scale will be used for the final grade for the course:

93-100% = A

90-92% = A-

87-89% = B+

83-86% = B

80-82% = B-

77-79% = C+

73-76% = C

70-72% = C-

67-69% = D+

63-67% = D

60-62% = D-

<60% = F

**Submitted Materials**

All typed materials are to be submitted via the dropbox on D2L. It is **each student’s responsibility to keep a copy** of **all** submitted tasks; each team member should have a copy of ALL components of group work. Also keep tasks after they are scored (e.g. in case of a grade dispute).

**Ethics Statement**

The Unit supports the codes of ethics published by the specialty organizations. Available online [8/20/08], <http://www.nsta.org/about/positions/professionalism.aspx>

# Resources

\*Konicek-Moran, R. & Keeley, P. (2015). *Teaching for conceptual understanding in science.* Arlington, VA: NSTA Press.

\*Keeley, P., Eberle, F., & Dorsey, C. (2008). *Uncovering Student Ideas in Science: Another 25 Formative Assessment Probes*. Arlington, VA: NSTA Press.

Knoicek-Moran, R. (2008). Everyday Science Mysteries: Stories for Inquiry-Based Science Teaching. Arlington, VA: NSTA Press.

Knoicek-Moran, R. (2009). More Everyday Science Mysteries: Stories for Inquiry-Based Science Teaching. Arlington, VA: NSTA Press.

\*Note. These texts for the course are available at Textbook Rental.

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Driver, R., Guesne, E., & Tiberghien, A. (1985). *Children’s ideas in science.* Philadelphia: Open University Press. UW-W Call # for reserve desk, Q181.A1 C49 1985

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Eisenkraft, A. (2003). Expanding the 5E Model: A proposed 7E model emphasizes "transfer of learning" and the importance of eliciting prior knowledge. *Science Teacher, 70* (6), 56-59.

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Governor’s Council on Model Academic Standards. (1998). *Wisconsin’s model academic standards.* Madison, WI: Wisconsin Department of Public Instruction. Available online [1/20/08], <http://www.dpi.state.wi.us/standards/index.html>; direct link to science, <http://www.dpi.state.wi.us/standards/sciintro.html>

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National Research Council. (1999). How People Learn: Brain, Mind, Experience, and School. Bransford, J.D., Brown, A.L., & Cocking, R.R. (Eds.) Washington, D.C .: National Academy Press. Available online [1/20/08], <http://www.nap.edu/html/howpeople1/>

National Research Council, Center for Science, Mathematics, and Engineering Education, (2000). *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning*. Washington, DC: National Academy Press. Available online [1/20/08], <http://www.nap.edu/readingroom/books/inquiry_addendum>

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**Tentative Schedule for**

**Teaching Science in the Elementary and Middle Schools (Section 2)**

**Spring 2017**

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| ***#*** | ***Date*** | ***Topics*** | ***K-6 Classroom Work*** | ***Assignments and Readings*** |
| 0 | Self-Paced  Due Mar 16 | **Online: Next Generation Science Standards Intro**  **The Three Dimensions of the NGSS**  What does it mean to teach more than just content?  **Scientific and Engineering Practices**-Part I   1. Asking questions (for science) and defining problems (for engineering) 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data   **Scientific and Engineering Practices**-Part II   1. Using mathematics and computational thinking 2. Constructing explanations (for science) and designing solutions (for engineering) 3. Engaging in argument from evidence 4. Obtaining, evaluating, and communicating information   **Crosscutting Concepts**-Part I   1. Patterns 2. Cause and Effect: Mechanism and explanation 3. Scale, proportion, and quantity   **Crosscutting Concepts**-Part II   1. Systems and system models 2. Energy and matter: Flows, cycles, and conservation 3. Structure and function 4. Stability and change   **Disciplinary Core Ideas**-Part I  Physical Science  Engineering, Technology, and Applications  **Disciplinary Core Ideas**-Part II  Life Science  Earth and Space Science | N/A | **Read**   * **Duncan & Cavera (2015)** * **Chapter 6 (pp.93-100)**   ***All Chapter readings are from Teaching for Conceptual Understanding in Science; All articles are on D2L***  **Complete Online Quizzes:**   * **Three-Dimensional Learning** * **Scientific and Engineering Practices Quiz #1** * **Scientific and Engineering Practices Quiz #2** * **Crosscutting Concepts Quiz #1** * **Crosscutting Concepts Quiz #2** * **Disciplinary Core Ideas Quiz #1** * **Disciplinary Core Ideas Quiz #2** |
| ***#*** | ***Date*** | ***Topics*** | ***K-6 Classroom Work*** | ***Readings and Quizzes*** |
| 1 | T: Jan 17 | **What is Inquiry?**  **The Nature of Children’s Thinking-Part I**  How do we find out what students already know?  What are naïve misconceptions?  How do naïve misconceptions affect learning? | Observe classroom routines/transitions and behavior expectations; what methods are used to teach? |  |
| 2 | T: Jan 24 | **Instructional Models**  What instructional models help focus on teaching for  conceptual change?  **The 7E Model of Science Instruction**  Why should activities come first?  **Science Trade Books**  What are trade books?  How can they be used to teach science concepts?  How can I find the NSTA Outstanding Trade Books? | Read an *Everyday Science Mystery* to the class;  Prepare before and after reading questions  Hand out & collect formative assessment probe | **Read**   * **Chapter 7** * **Eisenkraft (2003)**   **Complete Online**   * **Syllabus Quiz** * **Chapter 7 Quiz** |
| 3 | T: Jan 31 | **Online**  **The Nature of Children’s Thinking and Conceptual Change**  What conditions are necessary to change strongly held misconceptions/alternative views?  **Writing Objectives/Using Bloom's Taxonomy**  How should an objective be written?  How can an objective be turned into a Learning Target  (“I can” statement)? |  | **Read Chapter 4**  **View Objectives PowerPoint**  **Complete Online**   * **Chapter 4 Quiz** * **Objectives Quiz** |
| 4 | T: Feb 7 | **Instructional Strategies 1-4**  Why should an activity come before a concept?  How can analogies be used productively? | Read an NSTA Outstanding Trade Book to a classroom or group of students;  Prepare before and after reading questions | **Read Chapter 8 (pp.155-168)**  **Complete Online Chapter 8-Part 1 Quiz** |
| 5 | T: Feb 14 | **Instructional Strategies 5-9**  How can concept maps be used effectively?  How can the Frayer Model promote understanding? | Interview 3-5 students about a science concept based upon probes | **Read Chapter 8 (pp.168-176)**  **Complete Online Chapter 8-Part 2 Quiz** |
| 6 | T: Feb 21 | **Instructional Strategies 10-15**  What are talk moves?  What is the difference between predicting, observing,  and explaining?  What are thought experiments? | Teach an Inquiry Lesson using an Instructional Strategy | **Read Chapter 8 (pp.176-187)**  **Complete Online Chapter 8-Part 3 Quiz** |
| ***#*** | ***Date*** | ***Topics*** | ***K-6 Classroom Work*** | ***Readings and Quizzes*** |
| 7 | T: Feb 28 | **Scientific and Engineering Practice 1**  What makes a scientific question?  How do engineers define a problem? | Teach an Inquiry Lesson using a different Instructional Strategy |  |
| 8 | T: Mar 7 | **Classroom Safety**  What safety rules are needed for living things,  chemicals, and earth science materials  **Scientific and Engineering Practice 3**  How do scientists set up a variety of investigations?  What makes a fair test? |  | **Skim *Readings in Science Methods* pp.453-464 (posted on D2L)**  **View Safety PowerPoints**  **Complete online Safety Quiz, Pangea Lab, Germination Lab** |
| 9 | T: Mar 14 | **The Nature of Science**  What is science? How does it work?  What is the difference between hypotheses,  theories, and laws?  Why is it wrong to say there is a “Scientific Method”? | Teach a science lesson with a focus on Scientific and Engineering Practice (SEP) #1 | **Read Chapter 3, Robertson (2009), & McComas (1997)**  **Complete Online NOS Quiz**  **Formative Assessment Probe Project Due** |
| 10 | T: Mar 28 | **Scientific and Engineering Practice 2**  What are non-physical models?  How do scientists use models? | Teach a science lesson with a focus on one element from the Nature of Science |  |
| 11 | T: Apr 4 | **Scientific and Engineering Practice 6**  How can students make claims, use evidence and  explain their reasoning? (C-E-R) | Teach a science lesson with a focus on SEP #2 |  |
| 12 | T: Apr 11 | **STEM-Technology**  What is technology? | Teach a science lesson with a focus on SEP #3 |  |
| 13 | T: Apr 18 | **Classroom Management**  How can an inquiry-based classroom be  managed?  What reward/consequence systems are used  by teachers?  **Inclusive Science Teaching**  How can science be taught to all students? |  | **Read**   * **Sterling (2009)** * **Poon, Tan & Tan (2009)** * **Gomez-Swiep, Straits, & Topps (2015)** * **Childers, Watson, et al. (2015)**   **Complete online Classroom Management & Inclusiveness Quiz** |
| 14 | T: Apr 25 | **STEM-Engineering**  What is engineering? | Teach a science lesson with a focus on SEP #6 |  |
| 15 | T: May 2 | Final Classroom Teaching  Reflection upon Teaching Science | Teach a final “mini” lesson on a fun/engaging science topic |  |
|  | Final Exam | Essay Exam online |  |  |