**University of Montana**
**Teaching Science K-8**
**Fall 2012**

<table>
<thead>
<tr>
<th>Instructor:</th>
<th>Lisa M. Blank</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Office:</td>
<td>307</td>
<td>Phone:</td>
<td>243-5304</td>
</tr>
<tr>
<td>Office Hours:</td>
<td>As posted or by appt.</td>
<td>Class Hours:</td>
<td>M/W: 9:40-11:00; 12:40-2:00</td>
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</tbody>
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*Science is a way of thinking much more than it is a body of knowledge ~ Carl Sagan*

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**Required Reading Materials:**


Membership in the National Science Teachers Association. Membership includes a subscription to *Science and Children*, *Science Scope* or *Science Teacher*, and online access to all journal archives. Visit [https://secure.nsta.org/membership/new_member.aspx](https://secure.nsta.org/membership/new_member.aspx) to register ($35.00).

Keeley, P. et al. 2010 – 2012. *Uncovering student ideas in science series*. You will be assigned to purchase one of these volumes. Your volume can be purchased through a number of publishers: [http://uncoveringstudentideas.org/books/ordering-books](http://uncoveringstudentideas.org/books/ordering-books), but recall that your NSTA membership gives you a 10% discount on all purchases. If NSTA is back-ordered, you can always find a copy at: [http://www.mmsa.org/publications/uncovering-student-ideas-in-science](http://www.mmsa.org/publications/uncovering-student-ideas-in-science).

Moodle Course Supplement.

**Recommended Reading Materials:**


CURRICULUM & INSTRUCTION CONCEPTUAL FRAMEWORK

The conceptual framework places central value on learning as a collaborative endeavor. The faculty in C&I believe that an educational orientation is insufficient and outmoded if it is based on isolated content, is teacher-dominated, and directed primarily toward passive students learning alone. Thus, it is our Unit’s intent that teacher candidates at The University of Montana-Missoula will experience a cohesive learning community during their own preparation, with the goal that they will be disposed and equipped to create communities of learners in their own future educational settings.

The faculty has identified three essential elements of learning communities which form organizing themes or strands that permeate all the programs and drive the candidate proficiency outcomes:

- **Integration of Ideas**
  Members of a learning community look beyond the traditionally segmented curriculum and think creatively about the interrelationships among subject areas. They work with a variety of fields of study and search for unifying themes that cross disciplinary lines. There is an emphasis on explaining realities and dealing with actual problems in contextual learning situations.

- **Cooperative Endeavors**
  In a learning community, knowing and learning are viewed as communal acts, and all members can learn from each other. There is a commitment to engage all learners cognitively and emotionally in acquiring and sharing knowledge that is personally meaningful. In the process, members create a culture that encourages personal responsibility and active commitment to the group and its learning goals.

- **Respect for Diversity and Individual Worth**
  By definition, a learning community embraces diversity, requiring and valuing the input of all voices present. The ethics of care and mutual respect are viewed as essential for supportive learning environments that enhance each member’s self-esteem and foster risk-taking, creative conflict, and excellence.

**Course Description**

Welcome to Teaching Science K-8. How do K-8 students construct science understandings? Which classroom conditions foster opportunities for students to learn and enjoy science? What teaching strategies engage students in doing and understanding science? What does it mean to be a culturally responsive science teacher? These questions will be the guiding framework for this course. You will explore these questions by reflecting on your own and others’ science learning and teaching, and through reading and discussing research about science teaching and learning. We will pay particular attention to the science teaching approach modeled by the Next Generation Science Standards (NGSS). Your successful participation in class experiences and assignments will help you:

- Present and defend your beliefs about science teaching and learning (PEP 10.58.509 c);
- Articulate the essential elements of a scientific worldview and recognize science as a model building endeavor that seeks to systematically understand the natural world (PEP 10.58.508ii);
- Identify the essential elements of an indigenous worldview, gain confidence in identifying the characteristics of culturally responsive curriculum, and become aware of culturally integrated science resources, particularly those that develop a deeper understanding of Montana’s Indian nations (PEP 10.58.501d; PEP 10.58.509i));
- Explain how students’ science ideas and cultural context influence learning and become proficient in using questioning strategies, assessment probes, and scientific argumentation to reveal students’ science understandings (PEP 10.58.508ab);
- Use teaching strategies and curriculum that facilitate student interest and learning in science and are consistent with the NGSS teaching/learning model (PEP 10.58.394 a);
- Develop students’ critical reading and writing skills using science notebooks (PEP 10.58.508i);
- Become aware of the Science, Technology, Engineering, and Math (STEM) reform agenda and proficient in implementing STEM best practices in the classroom (PEP 10.58.508ii; PEP 10.58.509 ii);
- Apply research to the selection, comparison, and implementation of elementary science curriculum (PEP 10.58.305e);
- Understand ways to assess student learning in science and gain proficiency in using a variety of technologies to provide multiple means for students to demonstrate learning (PEP 10.58.305g PEP 10.58.509d)); and,
- Reflect upon your science teaching using student data, noting areas of mastery and areas of emerging growth (PEP 10.58.305k).

**Expectations**

Teacher candidates in the UM Department of Curriculum and Instruction are expected to demonstrate respect for diversity and individual worth, a clear commitment to learning to teach and to being a supportive colleague who can integrate knowledge of teaching pedagogy and content, and communicate professionally to diverse audiences.

Your intentional participation is essential to the success of the class and to your learning. For each class meeting, you should complete any reading or writing assignments, participate fully in classroom investigations, and positively engage in cooperative, thoughtful, knowledgeable discussions about your science ideas and actions.

Given the nature of the course, attendance, participation, and discussion are central components in achieving the course objectives. Be aware that it is difficult to make up absences when a majority of class time will be spent examining, manipulating, and negotiating science ideas. Absentees are responsible for contacting a peer for any in-class announcements, changes in the syllabus, and material discussed in class.

**Teacher candidates earning a grade of D or below or missing more than three class sessions (excused or unexcused) during the ten-week session do not meet professional behavior and competency expectations and will not qualify for placement in the five-week field component of this course.**

Assignments are due in class on the dates listed. Late assignments will not be accepted unless prior arrangements have been made with the instructor at least two days in advance.

I am always happy to answer questions about an assignment, but questions asked via email the evening before an assignment is due clearly indicate your priorities. While I respect your right to prioritize your time, please remember that your late-night panic should not be attributed to a lack of organization on my part. All assignments are discussed in class and include a grading rubric for you to follow. It is your responsibility to review these on the day an assignment is given and to direct any questions you may have during class or the following day.

Assignments will be graded using criterion-referenced methods, i.e., a specific set of standards. As a general guide, a “C” grade represents average work. It means that all assignments are done as described. A “B” grade represents above average work. It indicates that self-initiative has been taken to research
topics and bring more to the assignment than just required. An “A” grade represents a high level of mastery with evidence of reflection and research as well as personal innovation, relevant applications, and extensions.

**Should you have any questions concerning a grade, I am always happy to discuss them but ask that you make an appointment so I can give the matter careful consideration and maintain confidentiality. Prior to making an appointment to discuss a grade, please submit a written explanation of your concerns so that we are both adequately prepared for our meeting.**

Under no circumstances will I discuss a grade or student concern over email. As a teacher candidate it is expected that you demonstrate professional maturity by initiating direct communication when you have concerns. I reserve the right not to reply to unprofessional emails.

I will make every effort to reply to all emails within 24 hours if they are sent during the week. You should not expect replies to emails written during the weekend.

It is important to remember that effort alone does not necessarily guarantee above average grades; rather, high quality thought and products ensure above average grades. **To meet professional presentation standards required of practicing teachers, all written assignments must be word-processed, concisely written, fully referenced using APA guidelines, and stapled. All digital assignments must be submitted as a pdf file using the following file format: firstname_lastname.pdf.**

**Finally, please remember to show respect for the learning community. Consistent late arrivals, frequently leaving class, outside conversations, newspapers in class, reading materials not related to the class, texting, and ringing cell phones are a real distraction to other students. As well, the 400 block schedule is tight, so eating in class is hard to avoid. If you bring food and drink with you, please be sure to dispose of it appropriately.**

As it is my responsibility to maintain a productive learning environment, it is expected that cell phones and newspapers will not be present in class. If they are, I will ask you to put them away as their presence communicates a complete disregard for the learning community. If you do not want to be publically reminded of these expectations, then I encourage you to be mindful of these expectations.

If you consistently choose not to respect these professional dispositions and community expectations, an alert form will be filed and you will be asked to leave class for that day so that others who choose to be fully engaged learners may do so without distractions.

**Sequence of Topics & Assignments**

**Part I:**
**Topics:** The nature of science & engaging students in scientific practices: Evaluate alternatives, CER strategy, fair test, science notebooks  
**Assessment:** Evaluate Alternative Explanations Lesson Plan; Science Notebooks;

**Part II:**
**Topics:** Students' science ideas, teaching for conceptual understanding, 5E’s  
**Assessment:** Mental Model Assessment Probe Lesson Study; Model-It Lesson Study

**Part III:**
**Topics:** Place-based education; culturally responsive science curricula; STEM curriculum; assessment  
**Assessment:** STEM Curriculum Investigations

**Part IV:**
**Topics:** Clinical Field Experience  
**Assessment:** Teach science lesson and complete Science Teacher Work Sample
Course Assignments

Classroom Engagement

Participation/In-class Activities: This is due daily or as announced. Your attendance and participation are essential. I will take roll each class session and give one point for each full class attended.

Reading/Concept Quiz and/or Discussion Forum: Research shows that students learn more effectively with regular feedback regarding student learning targets. You will complete a weekly quiz or discussion forum post on Moodle that covers the course readings and science content explored during that week, with the exception of the final quiz which will be comprehensive.

Lesson Study Groups

Mental Model Assessment Probes Lesson Study: Learning science effectively requires that students first reveal and reflect upon their own science thinking. Mental model assessment probes focus students on the science learning target and initiate students’ “need to know”. You will present a 15-minute mental model to your Lesson Study group and participate in a discussion forum regarding the use of assessment probes in teaching science.

Model-It Lesson Study: Because science is inherently a “model-building activity”, the NGSS identify the use of models in science instruction as one of the five unifying concepts of science applicable to all grade levels. In this lesson study you will be assigned an elementary science concept and teach a 15-minute lesson using a model of your choice to explore the assigned science concept. Similies, analogies, metaphors, scale models, mathematical models, and computer modeling are all strategies you may consider for this lesson study. You will complete a lesson plan using the EIMA Model-It framework and submit a lesson study analysis.

Curriculum Investigations

Evaluate Alternative Lesson Plan: A major goal of the science curriculum is for students to develop an understanding of the scientific view of the world and to be able to use scientific reasoning when a situation requires it. The attainment of this goal is hindered when teachers require students to remember a great deal of scientific information without expecting them to understand the empirical and theoretical grounding of the knowledge. In this assignment you will adapt a Delta science lesson using an “evaluate alternatives” approach to give you practice in creating lesson plans that promote and support student engagement in scientific argumentation.

Five E’s Lesson Plan: Engage, Explore, Explain, Extend, Evaluate. These 5 steps have been shown to foster students’ conceptual, rather than definitional, understanding of science concepts. The 5 E’s lesson plan is an “industry standard” that Missoula County Public Schools now includes in its curriculum documents. For this assignment, you will adapt a Delta science lesson of your choice using the 5 E’s format.

Science Notebooks: Because of almost universal pressures to ensure student proficiencies in literacy and mathematics, it will be important to explore strategies that embed your science teaching within a literacy context. Science notebooks can be used to help students develop, practice, and refine their science understandings, while also enhancing reading, writing, mathematics and communications. In fact, schools that have focused on using science notebooks as part of their reform movement have found that the use of science notebooks increases students’ reading, writing, mathematics, and science scores on standardized tests. For this assignment, you will be required to complete a series of scientific investigations and maintain your data, conclusions, and science understandings in a science notebook that you construct.
**STEM Curriculum Investigations:** On August 11, 2011, Montana launched its STEM initiative with the goal of “creating a STEM literate citizenry and improving Montana’s economic competitiveness”. Nationally, five leading CEOs from Intel, Time Warner, Xerox, Kodak, and Sally Ride Science launched the *Change the Equation* initiative to solve America’s innovation problem. President Obama’s *Educate to Innovate* campaign intends to increase STEM literacy so that “all students can learn deeply and think critically in science, math, engineering and technology”.

All these entities argue that STEM is an economic imperative – “a literate nation not only reads. It computes, investigates, and innovates.” In this assignment you will explore a variety of STEM curriculum models and complete a STEM curriculum project. A detailed assignment outline will be provided in class.

**Clinical Field Experience**

**Science Teaching:** “Let’s do it again!” Those four words are a strong indication that your students are engaged. Mastery of facilitating meaningful science learning opportunities for your students can best be measured by performance. This assignment will have several parts, each designed to familiarize you with the components of a science lesson based on teaching for conceptual understanding.

**Part 1:** You will teach one science lesson in your clinical field experience. The lesson must use the classroom curriculum materials and target a discrete learning target(s) as identified by your classroom teacher.

**Part 2:** Effective science teaching requires that students first be made aware of their existing science ideas. As part of your science lesson you teach in the field, you will implement a strategy to reveal students’ pre-existing science ideas and focus their attention on the learning target. This may be a student drawing, concept map, prediction sheet, etc. You will ask students to revisit these at the end of your lesson and reflect on their current science understandings.

**Part 3:** You will complete a Teacher Work Sample of the science lesson by following the development of students’ science ideas. In your analysis you will submit documentation of students’ science ideas both before and after the science lesson and report on your assessment of the students’ understanding of the science concept. Your conclusions must use students’ science ideas to support your reasoning. A five E’s lesson plan of your science teaching must be submitted using the MCPS 5 E’s lesson plan format. A detailed assignment outline will be provided in class.

**Accommodations**

Please contact me following the first class meeting to arrange any teaching/learning accommodations you require.

**Graduate Students**

All graduate students must complete a graduate increment for this course. The graduate increment for this course will be participation in a research seminar attended by all graduate students and led on a rotating basis by participating faculty. The *science research seminar will be held during the week of September 17 – 21*. Exact location and times are TBA. For this seminar, you will be responsible for selecting a research article from a list of selected research journals, developing five discussions questions, disseminating the research article and questions to seminar participants by September 14th, and leading a discussion on your article during seminar. You must select your article from: *Science Education* or *Journal of Research in Science Teaching* (both are available in the Mansfield Library).
**Intellectual Honesty**

In the context of academia, intellectuals share and help shape each other’s ideas, and in doing so, they recognize each other’s contributions and give each other credit and recognition. Work that is not your own must be properly cited, whether the source is a classmate, a website, or a published text or curriculum. Taking credit for work you did not produce is plagiarism. This is a serious offense with consequences that range from a zero on the assignment to course failure or removal from the university, depending on the situation.

All students must practice academic honesty and be familiar with the Student Conduct Code. The Code is available for review online at [http://www.umt.edu/SA/VPSA/index.cfm/page/1321](http://www.umt.edu/SA/VPSA/index.cfm/page/1321).

**Dynamic Course Schedule**

**Week 1:**
THE NATURE OF SCIENCE: REASONING FROM DATA

**Week 2:**
ENGAGING STUDENTS IN SCIENTIFIC PRACTICES: EVALUATE- ALTERNATIVE MODEL

**Week 3:**
CLAIMS, EVIDENCE, AND REASONING STRATEGY
FAIR TESTS
Assignment:
   Evaluate Alternatives Lesson Plan

**Week 4**
TEACHING FOR CONCEPTUAL UNDERSTANDING
Assignments:
   Mental Models Lesson Study

**Week 5**
SCIENCE NOTEBOOKS

**Week 6**
INQUIRY, NGSS, & THE FIVE E’S INSTRUCTIONAL MODEL
Assignment:
   Science Notebook
   Five E’s Lesson Plan

**Week 7**
SCIENCE IS A MODEL-BUILDING ACTIVITY
Assignment:
   Model-It Lesson Study

**Week 8**
USING A PLACE-BASED INSTRUCTIONAL MODEL FOR CULTURALLY RESPONSIVE SCIENCE TEACHING
ASSSESSMENT
Week 9
EXPLORING STEM CURRICULUM
Assignment:
STEM Curriculum Investigations

Week 10
EXPLORING STEM CURRICULUM cont’d
Assignment:
STEM Curriculum Investigations

Weeks 12-15
TEACHING IN THE FIELD
Assignment:
Science Teacher Work Sample
Final Online Quiz

FINAL CLASS MEETING:

Section One: Wednesday, December 12; 10:45 – 12:00; PJW 241
12:00 – 12:45: Both sections meet for Lunch Celebration

Section Two: Wednesday, December 12; 12:45 – 2:00; PJW 241
**Grading Policy**

Final grades will be calculated based on the following percentages of total points:

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<tr>
<td>A 95-100</td>
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<td>A- 92-94</td>
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<td>B+ 90-91</td>
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<td>B 87-89</td>
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<td>B- 84-86</td>
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<td>C+ 81-83</td>
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<td>C 78-80</td>
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<td>C- 76-77</td>
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<td>D 68-75</td>
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<td>F Below 68</td>
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<td>Attendance</td>
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<td>Quiz/Discussion Forums</td>
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<td>Science Notebook</td>
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Please note that this document serves as a guide for course content and student evaluation. I welcome student input and reserve the right to be a learner as well as a facilitator. Thus, I may adjust this guide as the semester proceeds. Any changes will be announced in class.