ED 422: Teaching Secondary School Science  
Fall, 2014

Instructor  
Teaching Apprentice

Course Instructor: R. Charles Dershimer  
Christian Fischer

Office  
1302 B

Cell Phone  
734.274.1145

Email  
dersh@umich.edu  
chrisfi@umich.edu

Class Meetings:  
Tuesday, 4:00–7:00

Room 2241 (Science Methods Room)

First class meeting – September 2, 2014

Last day of class – December 9, 2014

Final Assignments Due – December 16, 2014

No Class – September 30, October 14 (Study Break)

Course Communication:

Office Hours: Fridays 2-4 or by appointment

Contacting Me: If you have thoughts, questions, or concerns about the course or teaching science more generally, please do not hesitate to contact me directly. Email is most convenient, and I check it regularly, but over the phone or texting at the above cell number is fine for more urgent matters. I can consult on both academic and professional matters, and if I cannot answer the question I work to direct you to someone who is able to help you.

CTOOLS site: www.ctools.umich.edu Log in with your uniqname and password and you will see a tab named EDUC 422 001 F14. Weekly reading, handouts, etc. will be posted on CTOOLS prior to class. Please note that I expect it to be your responsibility to check CTOOLS regularly. I will use email and CTOOLS extensively to communicate with you and to post and receive assignments and documents for class. Be sure to let me know if internet access will be a problem for you during the course.

COURSE OBJECTIVES

Students in EDUC 422 will:

1. Synthesize a personal rationale for teaching students science.
2. Developing Knowledge, Skills and Professional Judgment with the practices of science teaching in relation to the Teacher Education program outcomes and competencies.
4. Plan and enact instruction that addresses specific science learning objectives, supports safe and effective use of scientific practices, facilitates active learning and student sense-making, and assesses student understanding.
5. Modify and adapt curriculum materials and instruction to meet the diverse needs of classroom learners.
COURSE OVERVIEW\(^1\) (A teaching philosophy)

This course is designed to represent the most recent developments in our understanding of both science teaching, and teacher education. A variety of stakeholders in science education, including national organizations of teachers like NSTA\(^i\), and non-profit organizations dedicated to the advancement of science like the NRC\(^ii\), are increasingly recognizing and emphasizing the importance of science education that supports students in learning science through engaging in authentic science practices. A similar movement is taking place in teacher education, where teacher educators and education researchers are designing opportunities for novice teachers to learn teaching through ‘practice’ – by planning, trying out, and getting feedback on public enactments of specific teaching practices in both university and field settings.\(^iii\)

The course will provide you with a foundational set of tools for thinking about and teaching science as practice at the secondary level. Teaching science as practice means that the teacher guides students not only in learning the (age-appropriate) essential core knowledge shared by scientists and the scientific education community, but in developing an understanding of and experience with how scientific knowledge is constructed- by engaging students in the essential aspects of communal science practice for themselves, with intentional support from the teacher. This reform-based approach to teaching represents a departure from traditional science instruction, which typically emphasizes the transmission of a set of discrete science facts. It is also distinct from more general ‘hands-on’ or ‘discovery’ approaches, because of the way that teaching ‘science as practice’ works to hold students accountable to the norms of science as a discipline, such as supporting and defending claims using gathered data as evidence.

As novice science teachers, you will learn about the practice of teaching. The idea of “practice” can take on different meanings when learning to teach in a teacher education program (Lampert, 2009)\(^iv\). In learning to be a science teacher you will address “practice as an application of theory” in that you will be expected to warrant your knowledge of, capabilities with, or judgment about different teaching practices or decisions for science teaching using a principled or researched supported rational. You will learn about “the practice of teaching” by learning about and engaging in activities and ideas that are distinct to the professional science teacher community. You will learn about and demonstrate your skills with the “practices for teaching” using specific teaching moves or types of lessons that support student learning in the sciences. And finally, like any professional, we will engage in “practicing” or the repetition and rehearsing of specific teaching moves and practices to help us learn to do them well.

\(^1\) This syllabus document includes the work of L. Bricker, D. Peek-Brown, R. C. Dershimer, A. Kaplan, and A. Falk.
GUIDING QUESTIONS:

This course will address the following guiding questions to support instruction around student learning, standards and objectives, assessment and lesson design:

1) Who do we have to be as teachers to help all students learn science?
2) What does it mean for students to learn science and what science should students learn?
3) How do we engage and invest students in learning about science so that it is relevant and worthwhile in their lives?
4) How do we learn what assets and understandings students bring to the classroom, and how do we support them with effectively expressing their understanding?
5) How do we support and guide students in doing the important work of learning in a science classroom?
6) How do we foster a classroom environment that promotes learning?

Engaging students in science as practice will require you, in your role as a science teacher, to take up students’ initial ideas about how and why some aspect of the world behaves as it does. These initial ideas serve as the starting point for a cycle of science investigations in which students make sense of both data and text as a means of building on or changing their current understandings. As students develop new and more sophisticated scientific ideas based on the evidence they gather through their investigations, you will help them organize these ideas, evaluate these ideas, and connect them with other ideas and experiences. You will guide students as they work to form personal models of core scientific ideas. In addition, you will help students learn how to represent and communicate their developing ideas to others as students as they develop explanations to explain the world.

Teaching students to understand and enact ‘science as practice’ requires an instructional approach that is unfamiliar to many of us who experienced more traditional forms of science instruction in our own schooling. To develop understanding of and facility with teaching science as practice, we will focus in particular on learning to plan, enact, and reflectively learn from a core set of science teaching practices that are challenging and crucial to students’ science learning. While we focus on these core practices, we will continue to relate them to a larger framework and set of principles of science teaching and learning, to develop a sense of how these practices fit in to the larger picture of supporting your students as sense makers in your science classroom.
PRINCIPLES of LEARNING TO TEACH:

This course is organized around several core principles related to the nature of teaching and how those studying to become teachers learn the conceptual and practical work of teaching. The course structure and assignments reflect these principles, and we will periodically revisit the ways in which they are represented in what we read, do, and learn.

Teaching is intellectual work and requires specialized knowledge – Much of teaching goes on “behind the scenes” of what can be directly observed in a classroom. Good teachers rely on careful planning and reflection, are constantly interpreting evidence of their students’ understanding and capacities as individuals and a learning community, and make decisions about next steps based on their goals and the resources available to them. Teaching in science is therefore more than knowing science. Science teachers must not only understand science themselves. They must build an understanding of how students’ understanding of different topics develops, what ideas and experiences students bring that can be fruitful starting points and what ideas can cause them trouble. They need knowledge of the kinds of investigative activities and evidence that will provide opportunities for students to reason towards more accurate ideas and engage in science practices with appropriate guidance. (Magnusson, Krajcik, and Borko, 1999; Shulman, 1986)

Teaching is learned through opportunities to design, try out, and analyze practice - Teaching is more than an expression of innate personal style. It is a set of both general and science-specific knowledge and practices that are developed through opportunities to plan, experiment with, analyze, and receive feedback on their use. Some practices will draw on personal strengths already present, others will require intentional effort by you as a professional to develop, refine, and internalize. This will inevitably involve risk-taking, experimentation, hesitancy, and error, all of which are important parts of developing new understanding and practice, and are part of the experience of continuing growth for expert teachers throughout their careers. Together we will endeavor to create a safe and productive environment in which we feel free to stumble, and feel supported in learning from both successes and stumbles. (Lampert and Graziani, 2009)

An important part of teaching is making teaching public – While there is a history of individualism and privacy in teaching, it is increasingly evident that an important part of learning to teach (now and throughout one’s career) are opportunities to see oneself and others teach. To that end, we will be working to make our teaching public in a variety of ways, planning and reflecting together, watching video and model teaching by more experienced teachers, creating opportunities to rehearse teaching at different scales, and making and watching video of each other teaching. While this can initially be an intimidating prospect, by making teaching public, we create opportunities to question, analyze, and give and receive feedback that help us to better understand and refine what we do as science educators. (Little, 2002)

Teacher identity shapes what teachers know and do–How teachers see and understand themselves and their role as a teacher affects how they address their content, their students, and the communities in which they work. Teachers must examine their own beliefs and assumptions that arise out of their own personal histories in and out of school to develop visions of teaching and learning that will help all their students learn and grow. In an ongoing endeavor over their career, teachers need to develop the tools to study and improve their own practice and act as agents of change for students and schools. (Eick & Reed, 2002)
CLASS POLICIES: ATTENDANCE, READINGS, RELATED TASKS, AND CLASS PARTICIPATION

Preparation for and participation in class activities are essential to making the semester a productive opportunity for your own professional development, and for our class as a learning community; the importance of these components will be reflected in your “approach to learning” grade.

- **Attendance and punctuality** – Attendance and participation are expectations in this class as a form of professionalism. I expect you to attend every class, to arrive on time for a prompt start, to stay until the end, and to participate in and contribute to class. It is vital that you attend every class session if at all possible.

  There are three excused reasons for missing class: illness, family or personal emergency, religious holiday. If you cannot be present for a class session, let me know as soon as you know that you will be absent, but no later than 2 hours before class begins.

  Acceptable absences for religious holidays: please let me know at the start of the semester or at least two weeks in advance if you will miss class for this reason. While it will not be possible to recreate a missed class, please make arrangements with me to complete alternative work that will support the learning you missed. I will specify the due date for this alternative assignment. More than two absences from the class will make successful learning of the material in the course challenging and put you in danger of not being able to complete the course successfully. The Teacher Education Office will be notified if there are more than two absences. As always, participation points will be deducted for absences and late arrivals. Three absences—excused or unexcused—are grounds for failing this course.

- **Readings and related tasks** - You are expected to come to class having completed the reading and any related tasks that were assigned for that day. Completing the readings means reading assigned documents thoughtfully and critically, completing notes on these readings, and being prepared with any questions or connections you think are important to our conversations. You will periodically have additional tasks to complete in preparation for the class activities; you are expected to bring them in a form that you can share them with other members of the class.

- **Participation** - You are expected to participate in the class in positive and equitable ways. I understand that it is easier for some people to “put themselves out there” in class settings than others, and will work to create a space that we can feel safe taking risks in making public our ideas, questions, teaching practice, and constructive critiques. You are not expected to be talking all the time, but are expected to attend and contribute consistently and thoughtfully. There will be several regular formats for interaction, which will require slightly different forms of participation.
o **Small group and whole-class discussions** – You will regularly be working in small group and whole class formats to make sense of readings and class activities. This means taking risks in volunteering your own ideas, even if they are partial or uncertain; listening to and asking questions of others as they work to communicate their ideas; and reflecting on how your participation is contributing to your own learning and to that of the group as a whole.

o **Live enactments of core practices** – We will regularly be taking on the roles of secondary teachers and students as a way of working on and refining our teaching practice. Rather than merely going through the motions, you are expected to adopt these roles as authentically as possible, speaking and participating as a teacher, or a student just learning about the science. The more authentically we practice now, the better prepared we will be later on.

o **Seeking and providing feedback** – While it is hard to open your performance in an area you care about to scrutiny, part of becoming and developing as a professional is learning to seek, receive, and provide feedback in appropriate ways. You are expected to seek out, listen carefully to, clarify, and act on feedback from your instructor and your peers about the ways in which your practice is meeting or missing your instructional goals. You are also expected to provide feedback to peers on their own efforts to enact practice – this means offering both supportive comments, but also constructive criticism that will help them improve. We will work as a class on developing useful norms for feedback.

- **Electronics etiquette** – Laptops, cell phones, hand-held devices, and the internet have become essential parts of our daily life, and I love to use them as much as anyone. For this reason, I believe it’s important that we have some explicit expectations around their use during class time. While many of us may think otherwise, research is increasingly showing that multi-tasking significantly hurts our thoughtful performance.\(^2\) Therefore, I ask that electronic devices be off during class time, class breaks excepted, or when they are explicitly part of a task. In the case of laptops, if you use them to take notes or refer to readings, please refrain from non-class related activities while class is in session. If there are exceptional circumstances, please see me outside of class with your concerns, and we’ll make arrangements that will meet our needs.

University Policies related to classroom teaching and instruction:

(Adapted from L. Bricker, 2012 and from the Faculty Handbook from the Office of Services for Students with Disabilities)

1. Academic and Professional Integrity

It is expected that all members of this learning community will conduct themselves with integrity related to all aspects of our academic and professional lives. This includes making certain that plagiarism never occurs. If you are unsure about how to correctly attribute ideas, words, work, etc. to others, please ask. Please refer to the following websites for specific policies and procedures related to academic and professional integrity (undergraduate and graduate):

http://www.soe.umich.edu/file/academic_integrity/

http://www.lib.umich.edu/shapiro-undergraduate-library/types-plagiarism

Instructors are expected to report incidences of academic dishonesty to program administrators, who are then required to report them to Rackham Graduate School. Rackham's policy can be found at the following link: http://www.rackham.umich.edu/current-students/policies/academic-policies/section10#1022.

Specifically, section 10.2.2 of the policy defines plagiarism as follows:

- Representing the words, ideas, or work of others as one’s own in writing or presentations, and failing to give full and proper credit to the original source
- Failing to properly acknowledge and cite language from another source, including paraphrased text
- Failing to properly cite any ideas, images, technical work, creative content, or other material taken from published or unpublished sources in any medium, including online material or oral presentations, and including the author’s own previous work

Importantly, plagiarism can be intentional or unintentional. It is expected that SOE graduate students accurate reference sources using APA style.

According to this policy, Rackham Graduate School "will handle allegations involving Rackham students" at the SOE. Rackham's procedures for hearings of academic misconduct are detailed as a part of the policy.

2. Accessibility / Accommodations for Students with Disabilities

Every member of this learning community has the right to full participation.

If you are registered with the Office for Services for Students with Disabilities, please share your VISA (Verified Individualize Services and Accommodations) form with me at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way the course is usually taught may be modified to facilitate your participation and progress.
If you think you may need an accommodation to complete the requirements of this course, we can work with the Office of Services for Students with Disabilities (SSD) to help us determine appropriate academic accommodations. SSD (734-763-3000; http://ssd.umich.edu) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. Any information you provide is private and confidential and will be treated as such.

3. Discrimination/Harassment

No member of this learning community should be subject to discrimination of any kind and/or harassment, as these practices have no place in a just society. Please refer to the following websites for University policies related to discrimination and harassment:

http://urespect.umich.edu/report/what/#Report3

http://www.rackham.umich.edu/policies/discrimination_harassment/
COURSE ASSIGNMENTS

The course assignments are organized to provide you with opportunities to try out the teaching practices that are the focus of our work together in situations where you will receive support and feedback, and to periodically reflect on your own developing professional identity and understanding as a science teacher.

Use of Video: We will rely on digital video to capture records of our practice for subsequent viewing and analysis. If you do not currently have a camera capable of recording at least an hour of digital video with adequate sound quality, it may be most convenient to purchase one, with a mini tripod for stable recording. Alternately, digital video cameras can be reserved and checked out from the School of Education’s Brandon Center.

Parental Notification: To prepare for capturing video and student artifacts this fall you will need to distribute copies of a Parental Notification letter about making video records of practice in the classroom. These can be obtained from Jake Fox-Long in the Teacher Education office. I would suggest you work out with your mentor teacher to decide which two classes you will be the most likely to use for video recording, and pass out copies of the notification letters to every student in these two classes. Jake will provide you with copies of the letter, so please determine how many you will need before you make this request to him. I SUGGEST YOU GET THIS TAKEN CARE OF BEFORE 9/12.

A. Practice Teaching – Rehearsing Core Instructional Activities – In working to develop your knowledge of and skill with some core instructional practices, you will enact several key instructional activities in your clinical placement. You can enact these activities with your mentor teacher or include one of more of these practices as part of your multi-lesson teaching experience. You will be provided with more specific tools and guidance to support your thinking and enactment of each of these activities, but the general outline of the task structure for each the practice activities is as follows:

- Co-plan each of the instructional activities with your mentor teacher.
- Rehearse, review, and revise the practice with peers in your methods class and your field instructor.
- Enact the activity with students in your placement (as a whole class, in a focus group, or through individual interviews).
- Reflect on the enactment of your practice and review evidence (video, student artifacts, notes from your mentor teacher or field instructor) to describe how your teaching impacted your students.

Practice Activity 1: Engaging Students with a concept or phenomena – In science, and in learning more generally, new knowledge is constructed based on the ideas that people start with. A key initial step is therefore for students to articulate the ideas that they already have and for us as instructors to learn what these ideas are. Making these ideas public allows the class to build on productive ideas, challenge appealing but inaccurate ideas with evidence from investigation and text, and support or refute ideas through scientific argumentation. You will plan, rehearse, enact, and reflect on an activity that engages students with constructing initial models of a key science concept or interesting scientific phenomena. You will turn in your lesson plan, you will describe how your lesson progressed to support
students with building on this concept or phenomena, and you will provide evidence to
demonstrate what your students learned or did not learn from this experience.

**Practice Activity 2: Assessing student knowledge of a core scientific concept** – You will need
to design an assessment task in your clinical placement that helps you gather formative or
summative data on student learning or performance. The assessment task must be clearly
linked to learning objectives and state or national standards for what students are to learn in
the lesson. You should document how the assessment was scored and feedback was
provided to the students. You will provide student artifacts, examples of your scoring and
feedback to students, and you will analyze what these artifacts helped you learn about
students as sense makers in the science classroom.

**Practice Activity 3: Guiding students in making evidence based claims about a concept or
phenomena** – A core aspect of science is interpreting data to make and argue for claims in
relation to specific evidence. While it is crucial that students have experience with this
science practice, it is also important that their claims help them to move towards more
scientifically accurate understanding. As a teacher, you will play a critical role in helping
students learn how to argue scientifically and develop accurate knowledge. Based on an
activity in your clinical setting, you will plan, rehearse, enact, and reflect on facilitating a
discussion of laboratory data or scientific ideas in text to support students in making claims
and drawing more general conclusions about these claims. You will provide student artifacts,
and analyze what these artifacts say about student learning.

**B. Reflective Teaching — Review and Analysis of Different Model Teaching Practices for
Supporting ‘Science As Practice.’** Science classrooms can have students engaging in the
practices of science by supporting them with asking questions about scientific phenomena,
using models to support predictions and hypotheses, evaluating and analyzing data using
qualitative and quantitative thinking, and proposing reasonable explanations for questions or
solutions to problems by applying scientific concepts. To ensure that a laboratory or classroom
activity successfully helps students learn from these practices, students need to see models of
the practices, students need chances to practice using the scientific skills with guidance, and
the students need chances to use skill on their own. Over time students should move towards
being able to do independently what before they could only do with others’ support,
internalizing the guidance that was provided to them. This support (or scaffolding) is provided
by the teacher, by other students, and by tools such as written and visual guides, technology,
and classroom routines set up before the use of the phenomena. Teachers need to initially
provide more extensive scaffolding for students’ learning, and gradually remove or “fade” the
scaffolds in intentional ways to best promote the students performing independently.
(Vygotsky, 1978). Like your students, you need to see models of how to teach science as
practice to support your use of this kind of instruction. In your methods class you will
experience several example lessons that will model for you how to engage students in learning
science through the practice of science. You will analytically reflect on these experiences to
demonstrate your knowledge of the practice and your judgment for how these practices
support student learning.

You will observe, participate in, analyze, and reflect on six different model lessons this semester
that will take place in your methods classroom. For each of these different lessons you will
provide your observation notes from the experience and a 2-3 paragraph reflective analytical
essay. At the end of course, you will provide a final summative reflection on what you have learned from these model-teaching experiences in relation to the six guiding questions.

1. Model Lesson: “How can we provide clean water in a community?” (Earth Science)
   Focus Scientific Practice: Evaluating & Analyzing Collected Data; Proposing Reasonable Explanations or Solutions (Claim, Evidence and Reasoning).
   Focus Teaching Practice: Promoting and Managing Scientific Discourse (Running a class discussion, homework review, or reviewing laboratory data); Scientific Concept Formation (Engaging students with text)

2. Model Lesson: “What’s That Powder Under Grandma’s Sink?” (Chemistry)
   Focus Scientific Practice: Evaluating &Analyzing Collected Data
   Focus Teaching Practice: Setting Norms for Scientific Work (Laboratory Safety, and using laboratory data)

3. Model Lesson: “Why did the letters on the sign change in the rain?” (Forensics)
   Focus Scientific Practice: Using Models to Support Predictions or Hypotheses (If, Then, Because...)
   Focus Teaching Practice(s): Promoting and Managing Scientific Discourse (Running a class discussion, turning back to the text, and reviewing laboratory data); Scientific Concept Formation (Engaging students with text)

4. Model Lesson: Plants in Space Project – “How can we support plant growth?” (Biology)
   Focus Scientific Practice: Investigating Answerable Questions
   Focus Teaching Practice: Setting Norms for Scientific Work (Supporting individual, group work, and cooperative learning)

5. Model Lesson: Icy – Hot “How can we describe changes in matter?” (Physical Science)
   Focus Scientific Practice: Evaluating & Analyzing Collected Data; Using Models to Support Predictions or Hypotheses.
   Focus Teaching Practice: Promoting and Managing Scientific Discourse (Running a class discussion, homework review, or reviewing laboratory data); Scientific Concept Formation (Engaging students with text)

   Focus Scientific Practice: Investigating Answerable Questions; Using Models to Support Predictions or Hypotheses (If, Then, Because);
   Focus Teaching Practice: Promoting and Managing Scientific Discourse (Running a class discussion, homework review, or reviewing laboratory data)

C. Teaching Project - Designing and Enacting a Multi-lesson teaching sequence – While discussing, experiencing, and rehearsing teaching practices in your methods course provides important foundational learning experiences, it is also important to experience these practices in the more authentic complexity of a secondary classroom. Designing a multi-lesson sequence over multiple days will give you that experience.
You will plan and document your teaching of a multi day lesson using a lesson plan format (Learning Objectives, Assessments, and Instructional Activities) that is part of an identified 5 E unit in your content area. For your project you are to:

- **identify** a topic with your mentor teacher
- **develop** lesson plans for a multi-lesson teaching sequence including clearly written lesson objectives and assessments. You should co-plan with your mentor teacher.
- **enact** parts of these lessons in the classroom over the course of **two** days.
- **collect** both video records of your teaching and artifacts of the practices associated with the lessons.
- **write** a reflection paper on your enactment of the lesson with students.

This does not mean that you have to take over the class for two days, but that you should find time to introduce a topic on one day and follow up on the topic in the next day. This lesson should include one or more of the instructional practices addressed in this class.

**D. Professional Practice Examples** – Part of being a teacher is learning to use and adapt existing materials to meet your instructional objectives. In this activity you will research, identify, and reflect on three examples of instructional materials that you can make use of in your current or future teaching. You need to work with:

- an **article** from a teaching journal that allows you to think about or extend your practice
- an **example lesson** from a commercial, government funded, or professional source that you could potentially use in your teaching.
- an **example safety contract** and an activity that works to engage students with learning about laboratory safety.

For each of these documents you will submit a copy of the article, lesson, or safety contract, you will correctly cite the item and its source using APA guidelines, and you will provide a 1 page descriptive review of why you feel this item is interesting and useful based on the six guiding questions for this class. Note: It is my intention that these examples will be submitted for publication in the Michigan Science Teacher Associations Newsletter as part of helping you to establish a professional identity.

**E. Statement of Teaching philosophy** – Most teaching portfolios include a statement of one’s teaching philosophy – how the teacher conceives of learning in their discipline, and their role and responsibility as a teacher. You generally address your purpose in teaching; your beliefs about teaching and learning; your teaching strategies; how who you are as a person relates to who you are as a teacher; and the relationship between your purposes, beliefs, strategies and sense of self. You will have an opportunity to draft and revise this statement at several points over the course of the semester, both as an opportunity to craft a professional document that contributes to your job application process, as well as an opportunity to reflect on your own developing understanding of what it means to teach science.
Assignments; Submission, Grading, and Calendar of Completion

Submission Policies: Unless otherwise stated, all assignments are to be posted on the CTOOLS using the appropriate file name format by 11:55 pm on the day the assignment is due.

- Any handwritten documents should be scanned and submitted electronically.
- If an assignment includes multiple parts, please combine them into a single document rather than submitting multiple documents.
- Please use Microsoft Word or PDF file formats for written assignments.
- Please use a Quicktime file format when submitting video on M+Box.
- Please do not email assignments.
- Late submission may affect an assignment grade, and may result in a later return.

Extensions of one week may be granted on a case-by-case basis – please contact me by email in advance of the due date to request an extension. Assignments submitted on time may be revised and resubmitted for re-grading within one week of return. Please include a summary of revisions made based on feedback with the resubmission.

Grading: According to the points accumulated by the end of the semester, you will be assigned a letter grade based on the following percentages:

<table>
<thead>
<tr>
<th>Points</th>
<th>Grade</th>
<th>Points</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>95-100</td>
<td>A</td>
<td>90-94</td>
<td>A-</td>
</tr>
<tr>
<td>85-89</td>
<td>B+</td>
<td>80-84</td>
<td>B</td>
</tr>
<tr>
<td>75-79</td>
<td>B-</td>
<td>70-74</td>
<td>C+</td>
</tr>
<tr>
<td>60-69</td>
<td>C</td>
<td>Below 60</td>
<td>Must retake course and may not student teach until earning a grade higher than C</td>
</tr>
<tr>
<td>Assignments</td>
<td>Due Date</td>
<td>Points</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>----------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>Teaching Philosophy (Version 1)</td>
<td>V1 September 9</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Teaching Philosophy (Version 2)</td>
<td>V2 December 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Practice Teaching: Engaging students with concepts or phenomena</strong></td>
<td>Due 9/30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>• Modified Lesson Plan, Video Record of Practice &amp; Student Artifacts, Reflective Review of Enactment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Practice Teaching: Assessing Students</strong></td>
<td>Due 11/04</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>• Modified Lesson Plan, Student Artifacts, Reflection on Student Performance.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Practice Teaching: Guiding students in making evidence based claims</strong></td>
<td>Due 12/02</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>• Modified Lesson Plan, Video Record of Enactment with students &amp; student artifacts, Reflective Review of Enactment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reflecting on Practice</strong></td>
<td>Each is due within 24 hours of class</td>
<td>(10 points each reflection)</td>
<td></td>
</tr>
<tr>
<td>Submit a 2-3 paragraph reflection on each of the five model teaching experiences:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Water Cycle: Standards and Concept Formation (CF)</td>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>• Mystery Powder; Setting Norms and Data Analysis</td>
<td></td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>• Chromatography; Modeling and Use of Text for CF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Plants in Space; Classroom Discourse: Asking Questions &amp; PBL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Melting Curve; Modeling and Classroom Discourse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Final Model Teaching Reflection</td>
<td>Due 12/9</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Teaching Project</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Lesson Ideas and Teaching Dates</td>
<td>Due 10/07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Draft Detailed Lesson Plan including daily objectives, assessment, and instructional activities</td>
<td>Due 11/04</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>• Final Detailed Lesson Plan, Records of Practice from two day teach, and Reflective Review of the Enactment and Records of Practice</td>
<td>Due 12/16</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Professional Portfolio</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You will submit a copy of the article, lesson, or safety contract, you will correctly cite the item and its source using APA guidelines, and you will provide a one page (1-1.5 space) descriptive review of why you feel this item is interesting and useful based on personal beliefs and the six guiding questions for this course:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Example Safety Contract</td>
<td>9/23</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>• Review of Journal articles on idea or instructional practice</td>
<td>10/7</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>• Review of Published Lesson or Curriculum.</td>
<td>11/11</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Class Participation:</strong></td>
<td>2 points for each day in class</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>
COURSE MATERIALS

Articles: Articles will be available in CTools in the resource folder.

Required Text Resources: Required readings and assignments for the course will be posted on CTools. In addition, you will need to draw on both national and state standards documents as you develop your lesson plans. The required texts for this class can be found free at the following sites:


Available FREE at: http://www.project2061.org/publications/sfaa/online/sfaatoc.htm


Available FREE at: http://books.nap.edu/catalog.php?record_id=9853

Michigan Curriculum Standards: High School (8-12) Content Expectations (HSCE) and the Middle School Grade Level Content Expectations (GLCEs)

Available FREE at: http://www.michigan.gov/mde/0,4615,7-140-28753_64839_65510---,00.html


Available FREE at: http://www.nap.edu/books/0309074339/html/


Available FREE at: http://www.nap.edu/catalog.php?record_id=13165

Optional Texts: You may also wish to review the following texts for more details:


Available FREE at http://books.nap.edu/catalog.php?record_id=11311#toc

MEMBERSHIPS IN PROFESSIONAL ORGANIZATIONS

As a science teacher, you will find a membership in a professional organization invaluable. It will give you access to a professional community, journals that provide you with strategies and resources for teaching, professional development opportunities, etc. Membership is not needed for this course as access to the journals of these professional organizations is usually available through Mirlyn. However, you may find that you want to use some of the resources from these organizations which are only available through membership (i.e. job search support, teaching fellowships or grants).

National:
The most popular national science teacher organization is the National Science Teachers Association (NSTA). This organization caters to all science teachers regardless of grade or discipline. You can join as a student for $35.

- Website: [www.nsta.org](http://www.nsta.org)
- Publications:
  - Science Scope (middle school)
  - The Science Teacher (high school)

Local:
The two most popular local science teacher organizations are the Michigan Science Teachers Association (MSTA) and the Metropolitan Detroit Science Teaching Association (MDSTA). These organizations cater to all science teachers regardless of grade or discipline. You can join as a student for reduced fees ($30 & $10). I should disclose that I on the board of MSTA and I regularly work with U-M students and graduates to present at the MDSTA.

- Website: [www.msta-mich.org](http://www.msta-mich.org)
- Website: [www.mdsta.org](http://www.mdsta.org)

You might also be interested in joining a local or national professional organization that focuses on the scientific discipline you will be teaching. These resources often provide more rigorous and specific supports for teaching than NSTA. See the organizations listed below:

- National Association of Biology Teachers:
  - Publication: The American Biology Teacher

- American Association of Physics Teachers:
  - Website: [http://www.aapt.org/](http://www.aapt.org/)
  - Publication: The Physics Teacher

- American Chemical Society
  - Website: [http://portal.acs.org/portal/acrs/crg/content](http://portal.acs.org/portal/acrs/crg/content)
  - Publication: The Journal of Chemical Education

- National Earth Science Teachers Association
  - Website: [http://www.nestanet.org/cms/content/welcome](http://www.nestanet.org/cms/content/welcome)
  - Publication: The Earth Scientist (not available through Mirlyn)
READING LIST (Subject to revision) – This is a list of published readings that will serve as resources for citing the readings for this course. We will also read a number of documents prepared specifically for the Methods class.


## COURSE CALENDAR: EDUC 422 Fall 2014 (Subject to revision)

<table>
<thead>
<tr>
<th>When:</th>
<th>What:</th>
<th>How:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Topic: How Students Learn Model Lesson: First Day of School Model Biology Lesson: “How do seeds grow?” Reflection - How did our first day of class represent practices for; setting norms for learning in science, using discourse or discussion practices for active learning, and concept formation in science?</td>
<td>Please complete readings and assignments before class. All readings are located in c-tools resources folder or they are references in the required text section of the syllabus</td>
</tr>
</tbody>
</table>
| September 2 | How Students Learn: Prior Knowledge, Mental Models and Misconceptions Private Universe and Veristasium Video Questioning Practices for engaging students with phenomena. | Readings: No required readings. Suggested Readings:  
- Wong, H. “First Day of School”  
| Week 2    | How Students Learn: Prior Knowledge, Mental Models and Misconceptions Private Universe and Veristasium Video Questioning Practices for engaging students with phenomena. | Readings: Please read In this order-  
(1) Read In-depth to define misconceptions and conceptual change: Gooding and Metz (2011) “Conceptual Change.”  
(3) Skim to be able to describe how classroom talk supports student learning. Identify in detail the questioning practices you can use in your own science teaching: Michaels, S. & O’Connor, C. (2012). Talk Science Primer. (pp. 1-22). |
| September 9 | Standards – State and National: Model Earth Science Lesson: “How can we provide clean water in a community?” | Assignments:  
(1) Read the course syllabus and record any questions you have about the course.  
(2) Draft of Teaching Philosophy – 1-2 pages. Submit to C-tools assignment folder. |
| Week 3    | Standards – State and National: Model Earth Science Lesson: “How can we provide clean water in a community?” | Readings:  
(1) Read: Chapter 2 from A Framework for K-12 Science Education: Practices, Crosscutting, Concepts, & Core Disciplinary Ideas  
(2) Read: Chapter 14: Reforming Education from |
<table>
<thead>
<tr>
<th>Week 4</th>
<th>Standards - State and National Model Chemistry Lesson: “What’s that powder under Grandma’s sink?”</th>
</tr>
</thead>
</table>
| September 23 | **Readings:**  
(1) Read Chapter 3 in the Framework: Scientific and Engineering Practices.  
(2) SKIM your disciplinary (e.g., biology, chemistry, physics, earth science) content area standards on the Michigan Department of Education’s website: Link Here  
(3) SKIM through the applicable NGSS standards (relative to your disciplinary area): http://www.nextgenscience.org/search-standards-dci  
(4) Read Science and Safety: Making the Connection http://www.csss-science.org/safety.shtml  
(5) Review Laboratory Safety Video: Choose the high school or middle school video series and Watch the Chapter 1 – Why Safety is Important (~7:00 minutes) and Chapter 2 - The Teacher’s Duty of Care (~7:00 minutes) http://labsafety.flinnsci.com/Home.aspx |
| **Assignments:**  
(1) Professional Portfolio Due 9/23: Collect an example safety contract, and a lesson that helps students learn about laboratory safety  
(2) Reflection on Practice for Model Chemistry Lesson (due 9/24) |

| Week 5  | NO CLASS | **Readings:** I suggest you read ahead for class on October 7.  
Please watch these two videos to get a sense of |
### How to engage student prior knowledge:

**Video 1:** “Eliciting students ideas about gas behavior” (~30 minutes) [Link Here] or in C-tools Resources Folder

**Video 2:** “Building an initial consensus model and linking together parts of the causal story” (~30 minutes). [Link Here] or in C-tools Resources Folder

### Assignments:

1. **Practice Teaching: Engaging Students** Submit modified lesson plan, 15 minute Video Record of Practice, Student Artifacts, Reflective Review of Enactment.

### Readings:

Read one of the following chapters from *How Students Learn* in detail for practices:


2) Skim this article to get a sense of the different components of the 5E model and its design rational: Bybee (2006) “BSCS 5 E Instructional Model” (pp 1-19).

3) Read this to get a sense of how to use backwards design to create lessons: Wang & Allen (2003) “Understanding by design meets integrated science”

### Assignments:

1. **Professional Portfolio** – Review of Journal article on idea or an idea for instructional practice

2. **Reflection on Practice for Model Forensics Lesson** (due 10/08)

3. **Teaching Project**- Possible Lesson Ideas and Teaching Dates.

<table>
<thead>
<tr>
<th>Week 6</th>
<th>How Students Learn: Cognitive Model of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 7</td>
<td>Model Forensics Lesson “Why did the letters on the sign change in the rain?”</td>
</tr>
<tr>
<td>Lesson Design: 5E Lesson Design Workshop</td>
<td></td>
</tr>
</tbody>
</table>

<p>| Week 7 | MID SEMESTER BREAK |</p>
<table>
<thead>
<tr>
<th>Week 8</th>
<th>Assessment: Formative and Summative Assessment: Question writing Workshop</th>
</tr>
</thead>
</table>
NOTE: You will read the case that is appropriate to your discipline (Biology, Chemistry/Physics, Earth/Space Science). All cases are uploaded to CTools and clearly labeled.  
(2) Read Burton, Sudweeks, Merrill & Wood (1991). Better Multiple Choice Questions (pp. 1-33) |

<table>
<thead>
<tr>
<th>Week 9</th>
<th>Assessment: Making Expectations Clear Through Rubric Design and Use Model Biology Lesson: “Plants in Space Project” (Day 1)</th>
</tr>
</thead>
</table>
| October 28 | **Readings:**<br>(1) Read: Bednarski, M. “Assessing performance tasks,” *The Science Teacher*; Apr 2003; 70, 4; pg. 34  
**Assignment:**  
(1) **Teaching Project:** Draft detailed lesson Plan including daily objectives, assessment, and instructional activities |

<table>
<thead>
<tr>
<th>Week 10</th>
<th>Lesson Design: Project Based Learning &amp; Unit Design Model Biology Lesson: “Plants in Space Project” (Day 2)</th>
</tr>
</thead>
</table>
| November 4 | **Readings:**<br>(1) Read: *Read this article and focus on (1) How are groups used? (2) What roles do the students have, what roles does the teacher have?* Pratt, S. (2003). Cooperative learning strategies. The Science Teacher. Washington: 70(4) pp. 25-29.  
cooperative learning"

(3) **Jigsaw Reading:** Prior to class you will be assigned a reading to read and present in class. When entering class on Tuesday you will get together with the other students who are assigned the same article and create a poster describing the curriculum style reviewed in the article including example curriculum projects. You will then return to your base team to identify which unit design framework your team likes and why.

(STS)

(PBS)
- Constructing Extended Inquiry Projects: (PBS); Singer, Marx, Krajcik & Chambers (2000).

(DBS)
- Design Based Science (DBS); Fortus, Dershimer, Krajcik, Marx & Mamloc-Naaman (2004).

(PBL)
- Problem Based Learning (PBL) Chin & Chia (2004)

**Assignment:**

1) **Practice Teaching: Assessing Students**
Modified Lesson Plan, Record of Practice & Student Artifacts, Reflective Review of Enactment.

<table>
<thead>
<tr>
<th>Week 11</th>
<th>Lesson Design: PBL and Developing Explanations- The Claim Evidence and Reasoning (C-E-R) Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 11</td>
<td>Assessment: Assessment Using Rubrics Model Biology Lesson: “Plants in Space Project” (Day 3)</td>
</tr>
</tbody>
</table>

**Readings:**


3) Reading: Skim to identify how the C-E-R and data analysis are important in Project Based Learning. Moje, E. B., Peek-Brown, D., Sutherland, L. M., Marx, R. W., Blumenfeld, P., & Krajcik, J. (2004). Explaining explanations

3) Reading: Skim the Introduction and identify the applicable Common Core State Standards for Reading and Writing for Science and Technical Subjects that relate to the use of the C-E-R framework. On pages 3,
| Week 12 November 18 | Student Learning: Supporting Model Formation  
Model Physical Science Lesson: “Icy-Hot Lab- How can we describe changes in matter?” | Readings:  
Assignments:  
(1) Reflection on Practice for Model Physical Science Lesson (due 11/19) |
|-------------------|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Week 13 November 25 | Student Learning: Giving Feedback Workshop | Readings:  
| Week 14 December 2 | Assessment: State Testing Model Physics Lesson: “What Factors Impact Vehicle Motion?” | Readings:  
Assignments:  
(1) Practice Teaching: Guiding students in making evidence based claims. Lesson Plan, 15 minute Video Record of Practice, Student Artifacts, Reflective Review of Enactment.  
(2) NOTE: NO REFLECTION DUE ON MODEL PHYSICS LESSON |
| Week 15 December 9 | Lesson Design: Unit Design Workshop | Readings: None  
Assignments:  
(1) Reflection on Practice for All Lessons |
<table>
<thead>
<tr>
<th>December 16</th>
<th>FINAL MATERIALS DUE</th>
<th><strong>Assignments:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1) Teaching Philosophy Version 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) Teaching Project: Final Detailed Lesson Plan, Records of Practice, Reflection on Teaching</td>
</tr>
</tbody>
</table>

---

i See NSTA position statement: [http://www.nsta.org/about/positions/inquiry.aspx](http://www.nsta.org/about/positions/inquiry.aspx)


