Teaching Elementary Science  
Education 421 Fall 2011

Course Information
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Section 1
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Fridays 11:00 AM – 1:00 PM

Professor Betsy Davis is the lead instructor for the course. Students from either section are welcome to speak with her. Betsy’s contact information:
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If you have special needs for which accommodations may be needed, please inform your instructor as soon as possible.

Course Objectives and Organization
In Elementary Science Methods, we will build on current research and best practice to prepare you to foster science learning in elementary school students. Our main goals are for you to:

• describe the four strands of science learning—understanding scientific explanations (content), generating scientific evidence (through scientific practice), reflecting on scientific knowledge (and the nature of science), and participating productively in science
• incorporate the four strands of science learning into effective elementary science teaching to support students as they engage, experience, and explain with evidence.
• identify and enact instructional strategies that make science accessible to all students, including through connecting it to their lives
• learn how to prepare, teach, and analytically reflect on elementary school science investigation lessons

The expectations are high this semester. You've already experienced two semesters of coursework in the School of Education and two semesters in the field. This semester, we'll help you make connections between what you've learned already, and what you're learning now.

Throughout the semester, we will work on the goals listed above. We'll read relevant chapters and articles that can help us unpack the ideas related to these, and we'll also use other records of practice
(video, student work, etc.) to help bring some of the ideas to life. Each week, we'll be working on some key teaching practices, and you'll be practicing those practices in our ED421 class, in the field, or both. By the end of the semester, you should feel better prepared to put the pieces together to teach science effectively as a beginning teacher.

We’ve structured the class to allow for a focus on the elements of science lessons. Many science lessons can be broken down into three basic phases: engage, experience, and explain with evidence. Sometimes, these phases will span across a unit, rather than a lesson. We will work through different teaching strategies associated with each phase, focusing on using investigations to help students learn science content and scientific practices.

What are possible ways to engage, experience, and explain with evidence in science lessons? Watch for these elements when you observe science teaching. For example, you might see a teacher use a KWL or journal writing to engage students by eliciting their ideas at the beginning of a lesson, and/or the teacher might review previous lessons. For the experience phase, a teacher might provide students multiple opportunities to interact with scientific phenomena and concepts. For example, the teacher could have students conduct an investigation, supporting them in collecting and recording data systematically. S/he might also have students read a text, watch a video, or conduct research using the Web. In the explain with evidence phase of a lesson, the teacher might have students look for patterns in data, make claims based on evidence, construct a consensus model, or all of the above. Some of these approaches might, in turn, serve as formal or informal assessments.

**Course Reading Materials**

**Required Readings and Other Course Expenditures**


*Ready, Set, Science!* (abbreviated in the syllabus as RSS!) presents the most up-to-date discussion of reform-oriented science teaching. The book focuses on how you can incorporate scientific practices, such as scientific inquiry, into your elementary science teaching. Written for practitioners, it includes lots of nice descriptions of effective science teaching at the elementary level. You can purchase *Ready, Set, Science!* at Ulrich’s or online at http://www7.nationalacademies.org/bose/TSS_RSS_FAQ.html.

The other required readings are provided on CTools under "Resources" and within the "Weekly Resources" folder, by week.

In addition to the required readings, you should expect to need to spend no more than $25 to cover expenses associated with your science teaching in your elementary classroom.

**Additional Resources**

You may find some of the following books to be useful, as well. At least portions of these books are available online. Each is linked from the CTools site and from the CASES Resources page.


*Benchmarks* "specifies how students should progress toward science literacy, recommending what they should know and be able to do by the time they reach certain grade levels" (AAAS, p. xi). The Benchmarks are available at http://project2061.aaas.org/tools/benchol/bolintro.html. You may want to purchase this book if you are a science major; the URL is http://project2061.aaas.org/tools/bsl/index.html.

The *Atlas* provides a concept map view of the Benchmarks described above, demonstrating how the different concepts are interconnected. Some of the Atlas' maps are available on-line at http://www.project2061.org/tools/atlas/sample/toc.htm. You may want to purchase this book if you are a science major; the URL is http://www.project2061.org/tools/atlas/default.htm


*National Science Education Standards* are another set of national standards for science teaching; though many states have their own standards or frameworks, they are generally in line with the NSES. They are available on-line at http://books.nap.edu/html/nses/html/index.html. Please note that the Next Generation Science Standards are being developed and will replace the NSES soon (see http://www.nap.edu/catalog.php?record_id=13165)


Michigan Department of Education. *Michigan Grade Level Content Expectations*. The Michigan Department of Education has developed a set of standards for teaching science in Michigan. These science standards can be found in the Michigan Grade Level Content Expectations (GLCEs), available at www.michigan.gov/documents/mde/Item_C_194161_7.pdf.

CASES

The CASES learning environment is available at: http://cases.soe.umich.edu. CASES is a learning environment we developed to help preservice and new teachers like you as they learn to teach inquiry-oriented science. CASES includes links to many useful science teaching resources, including some inquiry-oriented science units. The project is funded by the National Science Foundation.

**Course Requirements and Grading**

The percentages listed here are approximate, but will give you a sense of the relative weight of each assignment. Expectations for these assignments will be discussed in more detail in class, and detailed assignment sheets will be provided. All written work, unless otherwise specified, is due by the start of class on the due-date, and should be uploaded to your drop-box on the ED421 CTools site.

**Class Attendance and Participation, including Minor Written Assignments (20%)**

"Attendance" means being in class on time and staying till the end. If you must miss class, send an email in advance to your instructor explaining the situation. In keeping with ongoing discussions in the School of Education, three absences—excused or unexcused—will constitute failure of the course. "Participation" means that you need to be in the habit of speaking up and being engaged in whole class and small group discussions and activities, including online opportunities. Class participation also includes minor written assignments such as the science teaching conversation with your mentor teacher and the peer observations feedback.

**Peer Teaching in ED421 (three times) (10% each time, or 30% total)**

Each peer teacher will have a chance to lead their peer "students" through each of the following three phases of a science lesson: *engage with an investigation question, experience the scientific phenomenon...*
associated with the investigation, and explain the phenomenon with evidence to his/her peer teaching team. We refer to the three phases of science teaching as the “EEE framework for science teaching”.

"Experience" Phase Teaching in the Field (one time) (20%)

Teaching the Experience phase of a lesson will involve co-teaching a science lesson with your mentor teacher in your field placement classroom. The goal is to apply ideas being learned in ED421 to practice small elements of science teaching, sometimes in low-stakes environments, so that when you are teaching entire science lessons (with multiple elements), you will have already developed some expertise. You should plan to teach the “experience” phase of an investigation lesson in your field placement classroom. You will also collaboratively review video records of this lesson with colleagues.

Reflective Teaching Assignment (30%)

You will teach a full science lesson in your practicum classroom. For the reflective teaching (RT) assignment, you will develop a science lesson plan using existing science lessons and other curricular resources, analyze the lesson plan using analysis criteria, teach the lesson to children, reflect on your teaching using your video record, and analyze some student work.

Class Policies and Additional Information

Contacting Us

Email is the best way to reach us. You can also call us, come to our office, or leave something in our mailboxes.

Grading and Late Work

If you cannot complete an assignment on time, please contact your instructor by email and request an extension. Typically we will give an extension of one week; after that, the work will be counted as late and your grade will be affected.

You may request a re-grade on any assignment. The request must be made via email and you must turn in the revision within one week of the assignment being handed back.

Readings

You are expected to do all the reading in advance of class. Our work in class depends on it.

Written Assignments

For turning in your written assignments, you will use the drop box area in the CTools site.

Participating in Program Evaluation and Research

You received information last year about teacher education program evaluation and research. If you have any questions, please ask us or your field instructor. You or your mentor teacher have also received a letter to the parents or guardians of the children in your classroom. These should have already been distributed by now, but if not, please make sure you follow the instructions you receive about signing, copying, and distributing these letters.

Questions, Comments, or Concerns

If you have any questions, comments, or concerns about the class, please do not hesitate to contact us! We’re looking forward to working with you this semester!
### Summary of Assignment Due Dates (see syllabus and handouts for more complete explanations)

<table>
<thead>
<tr>
<th>Week &amp; Date</th>
<th>Today's In-Class Topic</th>
<th>Reading for Today</th>
<th>Assignments due today</th>
<th>Peer teaching today...</th>
<th>Field assignments this week</th>
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<tbody>
<tr>
<td>(1) M10/10</td>
<td>Our visions of science teaching</td>
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<td>Get familiar with science</td>
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<td>T10/11</td>
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<td>Sci. conv. w/ MT</td>
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<td>(2) M 10/24</td>
<td>Engage: What should be taught and learned in elementary science? Sci. education standards, scientific practices, and EEE framework</td>
<td>GLCEs RSS! ch. 1, 2, &amp; 4</td>
<td>Science conversation with MT</td>
<td>Prepare for Engage peer teach</td>
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<td>T 10/25</td>
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<td>(3) M 10/31</td>
<td>Engage: Students’ ideas in science and beginning an investigation lesson</td>
<td>RSS! ch. 3 Watson &amp; Konicek Benchmarks ch. 15 MSTA misconceptions</td>
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<td>Engage peer teach: Establish purpose through question or problem; share initial ideas</td>
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<td>(4) M 11/7</td>
<td>Experience: Investigations as learning activities I (Establishing data collection)</td>
<td>RSS! ch. 5, 6 &amp; 7</td>
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<td>Prepare for Experience peer teach</td>
<td>Experience phase teach-in-field</td>
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<td>T 11/8</td>
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<td>(5) M 11/14</td>
<td>Experience: Investigations as learning activities II (Carrying out the investigation, fostering students’ sense-making with data)</td>
<td>RSS! ch. 5, 6 &amp; 7</td>
<td>Fri, 11/18 First Round: Experience Phase Video Discussions</td>
<td>Experience peer teach: Establish data collection; carry out investigation to support sensemaking</td>
<td>Experience phase teach-in-field</td>
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<td>(6) M 11/21</td>
<td>Explain with evidence: Closing an investigation lesson I (Discussions with data, supporting students in making evidence-based claims)</td>
<td>Abell et al. McNeill &amp; Krajcik: ch. 1; excerpts ch. 2 (pp. 18-25; p. 30)</td>
<td>Experience phase teach-in-field due</td>
<td>Prepare for Explain with Evidence peer teach</td>
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<td>(7) M 11/28</td>
<td>Explain with evidence: Closing an investigation lesson II (Supporting students in applying scientific knowledge to new situations)</td>
<td>RSS! ch. 5, 6, &amp; 7</td>
<td>Fri, 12/2 Second Round: Experience Phase Video Discussions</td>
<td>Explain with Evidence peer teach: Revisit question; support claims with evidence; communicate and justify explanations; apply knowledge</td>
<td>RT</td>
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<td>(8) M 12/5</td>
<td>Assessment: Constructed response as a form of assessment in science</td>
<td>McMillan ch. 8 &amp; 9</td>
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<td>(9) M 12/12</td>
<td>Putting it all together: Final synthesis and reflections on course</td>
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<td>RT due 12/15</td>
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<td>T 12/13</td>
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Tentative Course Schedule and Assignments

The schedule on the following pages is likely to change as the course progresses! Homework assignments may be assigned in addition to the assignments listed here. All assignments are due by the time class starts, unless otherwise noted by the instructor. Readings other than chapters in Ready Set Science! are posted on CTools.

Week 1 Monday, October 10, or Tuesday, October 11 What is our image of science teaching?

Goals for today: Introduce the course, think about personal experiences as science learners, and introduce strands of proficiency in science. Begin to establish a culture of intellectual respect. Think about your goals for yourself as a science teacher.

Connections: Reflect on your experiences learning science and ideas about what effective science teaching entails. What is your history as a science learner? What are your goals for yourself as a science teacher? How does effective elementary science teaching connect to effective teaching in other subjects?

Science teaching practices to work on: Introducing the Engage, Experience, and Explain with Evidence phases of a science lesson.

Equity in science teaching and learning:
- Making science accessible to all learners is one of the key goals you must have as an elementary teacher. As you begin this course, consider what you can do to help all learners succeed with science. Observe and talk with your mentor teacher to gain insight.

What to work on in the field this week: This week, get familiar with your classroom. How is science visible? How has the teacher established a culture of intellectual respect? Does the physical layout allow all students to participate equitably in science? Use your conversation with your mentor teacher (due October 24 or 25) to learn more about how s/he thinks about and works on science teaching.

No class Monday, October 17, and Tuesday, October 18 Fall break!

Week 2 Monday, October 24, or Tuesday, October 25 EEE: Engage & Standards & Strands

Goals for today: Begin to understand what is meant by "scientific practice", "scientific inquiry", "investigation", "phenomenon", "prediction", etc. Begin to recognize what scientific practice can look like in an elementary classroom. Develop beginning understanding of the instructional continuum from more teacher-directed to more student-directed.

Connections: In Teaching with Curriculum Materials, you explored the GLCEs; here, we'll zero in on the science content GLCEs and what is called the science process GLCEs (which we refer to in class as being about scientific practices). In your social studies methods class, you worked a lot on representing how history is done. Investigation of natural phenomena is one characteristic that makes science unique. As in history, students will use evidence to support claims in science. The evidence will be a little different!

Science teaching practices to work on: Analyzing and modifying science lesson plans; recognizing and identifying common patterns of student thinking in science.

Equity in science teaching and learning:
- How does having clear standards and using these to guide your instruction help you make science accessible to all learners? What do you need to do to be able to recognize the strengths in all children's science ideas? How can you build on these ideas in your instruction?
Readings for today:
- Michigan Grade Level Content Expectations (GLCEs) for science
- Ready Set Science! chapters 1, 2, and 4

Peer teaching in class today:
- Prepare for the Engage peer teach

Assignments due today:
- Science conversation with your mentor teacher

What to work on in the field this week:
- Observe science lesson(s) if possible. Do you see elements of the EEE framework, even if it's not explicit?

Week 3 Monday, October 31, or Tuesday, November 1 EEE: Engage & Students' ideas

Goals for today: Begin to be able to envision a science investigation lesson. Develop strategies for finding out about and working with kids' ideas in science. Learn how to support students in making predictions about phenomena.

Connections: You learned about the importance (and resilience!) of students' ideas in Children as Sensemakers, ed psych and your other classes. Think back to Children as Sensemakers from last fall. How can you elicit, identify, and work with kids' ideas in science?

Science teaching practices to work on: Using discourse moves to elicit students' ideas in science; leading whole-class discussions; recognizing and identifying common patterns of student thinking in science

Equity in science teaching and learning:
- How does your own use of specific discourse moves help to support students in learning the academic language or academic register of science? How can you explicitly support children in being able to use precise, clear, accurate language in science? What kinds of scaffolding can you provide?

Readings for today:
- Ready Set Science! chapter 3
- Watson & Konicek (1990): Teaching for Conceptual Change
- Benchmarks Chapter 15: The Research Base
- MSTA misconceptions lists (physical science, earth science, life science)

Peer teaching in class today:
- Engage peer teach: Establish purpose through a question or problem; share initial ideas to connect lesson to students’ ideas, knowledge, and experiences

What to work on in the field this week:
- You may teach your Experience phase teach-in-field assignment this week. It must be completed by November 21 or 22.

Week 4 Monday, November 7, or Tuesday, November 8 EEE: Experience – Data collection

Goals for today: Continue to develop skill in teaching a lesson involving an investigation. Learn how to support students in collecting, recording, and organizing data.
Connections: Continue to apply your knowledge about teaching (in general) to thinking about science teaching. Also, as with mathematics (and other subjects sometimes as well), you need to think about how you will make physical materials available to students without causing distractions.

Science teaching practices to work on: Supporting students in making predictions; modeling and scaffolding data collection and recording; leading whole-class discussions; setting up and managing small group work for investigations in science.

Equity in science teaching and learning:
- In what ways does investigation help to make science accessible to a broader range of learners? In what ways might some children be disadvantaged, and how can you work to mitigate those disadvantages? (Consider, for example, the kinds of discourse moves we've been working on; consider also how you might use flexible roles in collaborative groupwork; consider even the physical layout of your classroom.)

Readings for today:
- Ready Set Science! chapters 5, 6, and 7

Peer teaching in class today:
- Prepare for the Experience peer teach

What to work on in the field this week:
- You may teach your Experience phase teach-in-field assignment this week. It must be completed by November 21 or 22.

Week 5 Monday, November 14, or Tuesday, November 15 EEE: Experience – Sensemaking

Goals for today: Continue to develop skill in teaching a lesson involving an investigation. Learn how to support students in analyzing, interpreting, and representing data.

Connections: Continue to apply your knowledge about teaching (in general) to thinking about science teaching. You may have taught a “visual inquiry” lesson in social studies. Investigations are an element of scientific inquiry. How is interpreting data similar to and different from interpreting a historical image?

Science teaching practices to work on: Supporting students in collecting and recording data; supporting students in making sense of data while investigating; circulating during investigations and scaffolding student thinking through questions; establishing norms and routines for classroom discourse and work that emphasize the use of evidence to support claims; setting up and managing small group work for investigations in science.

Equity in science teaching and learning:
- What kinds of scaffolding will help support students in recording their data in such a way that they'll be positioned to make sense of it? What kinds of questions can you ask small groups while they're engaged in small-group investigative work to support their thinking about the phenomena they're exploring (not just address groupwork, behavioral, or materials-related issues)? How can norms and routines for classroom discourse help work to mitigate gaps in students' prior experiences that might otherwise make them less prepared for ambitious science learning?

Readings for today:
- Continue to explore Ready Set Science! chapters 5, 6, and 7

Peer teaching in class today:
- Experience peer teach: Establish data collection; carry out investigation to support sensemaking
What to work on in the field this week:

- You may teach your *Experience* phase teach-in-field assignment this week. It must be completed by November 21 or 22.

**Week 6** Monday, November 21, or Tuesday, November 22  
**EEE: Explain – Claims & evidence**

**Goals for today:** Continue to develop skill in teaching a lesson involving an investigation. Learn how to support students in making sense of data that have been collected. Learn how to support students in making claims based on evidence.

**Connections:** In social studies methods, you learned about primary and secondary sources. These are sort of like "data" or "evidence" in science. How could you help students learn about scientific practices and historical inquiry? How could you help them see connections between the two subject areas?

**Science teaching practices to work on:** Compiling student (or group) data and supporting students in looking for patterns; supporting students in developing claims based on evidence; leading whole-class discussions; establishing norms and routines for classroom discourse and work that emphasize the use of evidence to support claims.

**Equity in science teaching and learning:**

- We've been working on establishing norms and routines for classroom discourse. How can emphasizing the use of evidence to support claims help all children learn science? How can the work of compiling student or group data help make visible some of the hidden "steps" of data interpretation?

**Readings for today:**

- Abell et al. chapter: Science as Argument and Explanation
- McNeill & Krajcik chapter 1 (pp. 1-17), excerpts from chapter 2 (pp. 18-25; p. 30)

**Peer teaching in class today:**

- Prepare for the *Explain with Evidence* peer teach

**Assignments due today:**

- *Experience* phase teach-in-field is due today.

What to work on in the field this week:

- No field – enjoy the Thanksgiving break!

**Week 7** Monday, November 28, or Tuesday, November 29  
**EEE: Explain – Applying knowledge**

**Goals for today:** Continue to develop skill in teaching a lesson involving an investigation. Learn how to design opportunities for students to apply their knowledge to new situations.

**Connections:** How is applying knowledge to a new situation in science similar to how you tie ideas together in other subjects?

**Science teaching practices to work on:** Supporting students in applying scientific knowledge to new situations; explaining core content; establishing norms and routines for classroom discourse and work that emphasize the use of evidence to support claims.

**Equity in science teaching and learning:**

- Supporting students in applying their scientific knowledge to new situations is one way of seeing how students are understanding the science. It can, however, be problematic if the new
situations aren't chosen very carefully to build on students' prior experiences. How can learning about your students and their community help you be better positioned to do this well?

Readings for today:
- Continue to explore Ready Set Science! chapters 5, 6, and 7

Peer teaching in class today:
- Explain with Evidence peer teach: Revisit question; support claims with evidence; communicate and justify explanations; apply knowledge to new situations

What to work on in the field this week:
- You may teach your Reflective Teaching lesson this week. It must be completed by December 15.

Week 8 Monday, December 5, or Tuesday, December 6 Assessing students' understanding

Goals for today: Develop skill in looking at students' written work over time. Practice assessing student work in science via constructed response opportunities. Practice interacting with parents about student learning. Continue working on how making real-world connections can help make science accessible.

Connections: You've learned about assessment in all of your classes. Here, we'll be focused on closely examining student work in science—particularly via constructed response questions and performance assessments—and being able to make claims about their development over time.

Science teaching practices to work on: Assessing students' ideas; recognizing and identifying common patterns of student thinking in science

Equity in science teaching and learning:
- Consider how you can use assessment as a way of positioning students to be successful in science. How can different forms of assessment support students?

Readings for today:

What to work on in the field this week:
- You may teach your Reflective Teaching lesson this week. It must be completed by December 15.

Week 9 Monday, December 12, or Tuesday, December 13 Putting it all together

Goals for today: Pull back to consider the broader implications of what we've learned about effective science teaching.

Connections: Think about how what you've learned this semester about effective science teaching connects to what you've learned in your other teacher ed coursework and in the field. What do you want to make sure to work on during student teaching?

Equity in science teaching and learning:
- Reflect back on the semester. What have you learned that can help position you to be able to make science accessible for all students? What do you need to keep working on?

Assignments due today:
- Reflective Teaching assignment is due on Thursday, December 15 (both cohorts).