2015

TEAC 315: Teaching Science in the Elementary School—A Peer Review of Teaching Project Benchmark Portfolio

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TEAC 315:
Teaching Science in the Elementary School
A Peer Review of Teaching Project Portfolio

Krista Adams
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**Description of the Course**

*Teaching Science in the Elementary School (TEAC 315)* is an upper-division course taken by elementary education majors as a requirement for the Bachelor of Science (BS) in Education. Students enter the methods course with two semesters or more of teaching experiences. The course typically enrolls 24 students the semester prior to student teaching. The students enter the course with the requisite two or three introductory science courses (e.g., entomology, meteorology, geology). The course is designed to build on students’ prior knowledge of science and experiences in the elementary education program including teaching experiences. In addition, it aligns with the University of Nebraska-Lincoln (UNL) Department of Teaching, Learning and Teacher Education (TLTE) mission to prompt teacher candidate service teachers (Teacher candidates) to see their professional careers as works-in-progress rather than as finished products.

The science methods course consists of developing instructional strategies, selecting curriculum, analyzing student learning through assessment, and addressing classroom management for teaching inquiry-based science. Content from the three domains of science (life science, physical science, and Earth & space science) will be used as vehicles for learning about teaching science to diverse groups of students. The course aims to develop Teacher candidates personal teaching philosophies of the nature and importance of science education and how students learn science best according to current educational research findings. The course also emphasizes a practical and reflective approach in how to: (a) develop a scientific classroom discourse community of active learners of science; (b) use and design inquiry-based curricula; and (c) evaluate one’s own instructional practices. Students are expected to demonstrate knowledge of science content knowledge relevant to Nebraska Standards and appropriate for
grade K-6. A variety of science topics will therefore form the context for each lesson. Some of these will be science content knowledge that addresses areas that Teacher candidates had identified as difficult, others to satisfy the existing public schools’ curriculum or might emerge from science content courses.

**Course Outcomes**

The purpose of teacher preparation programs is to help teacher learners in developing the tools to study teaching. Teacher candidates must begin to form the habits and skills necessary to analyze their practices in light of students’ needs and understandings (Feiman-Nemser, 2001). The Content Representation (CoRe) document created by Loughran, Berry and Mulhall (2006) serves as one way for the teacher learners to identify why and how instruction is being taught to a particular group of students. For my elementary science methods course, the teacher learners develop a CoRe document they will teach in a K-5th grade classroom. After implementing the lesson, they analyze their instruction to determine what they changed or might change based on students responses and alignment to course readings. This practice encourages teacher learners to consider the impact of instruction on the learning experiences. Many teacher learners discuss that this is the first time they realize the importance of self-reflection on the teaching and learning experience. The practice of analyzing instruction helps foster the norms for professional growth and improving classroom practices to meet the needs of students.

The elementary science methods course aligns with my research framework of building a teachers’ responsive repertoire. A responsive repertoire involves designing and implementing various instructional strategies (e.g., laboratory experiments) in light of the needs of the students (Clermont, Borko, & Krajcik, 1994; De Jong & van Driel, 1999; Friedrichsen et al., 2009). In the classroom, a teacher of science must be aware of the students’ prior knowledge, difficulties and
misconceptions about the concept(s). Similarly the science teacher educator must be aware of the difficulties with, resistance of, and experiences that teacher candidates might have when learning about teaching science (Abell, Rogers, Hanuscin, Lee, & Gagnon, 2009). Besides the students’ understandings the teacher must be aware of their own beliefs, orientations and views towards science (Friedrichsen et al., 2009). Thus the process for developing and implementing instruction for this course is informed by the teacher candidates’ views as they design and implement instruction in order to impact student learning. If a teacher views science as didactic – a transmission of facts, the instruction and interpretation of student feedback will provide a different outcome than a teacher that views science as discovery – provide opportunities for students on their own to discover targeted science concepts (Magnusson 1990). See Figure 1 for the interaction of teachers’ views to how instruction is developed and implemented.

Figure 1. Interaction of teachers’ orientation and teaching science
The course aims to develop Teacher candidates’ responsive repertoire through the discipline of science. To address this, I provide experiences that model 5E lessons, collaborate with peers to design and implement science lessons for an after schools science club at local Community Learning Centers (CLC), and engage in professional development (e.g., trip to zoo, science lectures) to support teaching and learning science. The aims of the course are accomplished by providing activities that engage teacher candidates in:

- Reflection on prior experiences with science from the K-16 view both in school and in informal settings (e.g., museums, field trips, parents);
- Participation in and reflect on reform-based science lessons as both the teacher and student;
- Field Experience in the after school setting for K-5th grade children;
- Reflect on science instruction impact on student learning;
- Read and synthesize course readings in light of course goals, knowledge of student understanding, and personal experiences with teaching and learning science;
- Engaging in professional development experience.

The specific goals that students will demonstrate are aligned to TLTE’s core themes to demonstrate support and growth across the course. Students will develop: (1) understanding of the central concepts (content), tools of inquiry (process skills), and structure of science (the nature of science) appropriate to teaching at the K-6 level; (2) understanding of the social, intellectual, and personal development of students and recognize the diverse needs, interests, and abilities of students in regard to science at the K-6 level; (3) knowledge of and ability to critically evaluate and utilize contemporary science standards (state and national) and curriculum
materials for science education; (4) knowledge of and ability to plan and implement a variety of instructional strategies and assessment techniques for teaching science at the elementary level; (5) the capacity to create a positive environment that encourages science learning by modeling the attitudes and dispositions of scientific inquiry; and (6) the capacity for collegiality, reflective practice, and professional growth in regard to science teaching.

Knowledge of Teachers’ Understanding of Science and Science Teaching

The knowledge of students’ understanding about teaching science teachers looks at teachers’ prior knowledge and experiences with teaching science, and teachers’ difficulties and misconceptions about science content. I initially approached this course based on my own experiences teaching science to 8th graders and introductory chemistry to college freshman. Science was understood by mathematical equations, writing and reading involved primarily science textbooks with some use of science fiction, and knowledge about the time in history and culture helped understand the world. My ideas aligned to a departmentalized school structure (i.e., upper elementary, middle and high school) with little emphasis on an interdisciplinary design. In a departmentalized structure, the content specialist (e.g., math, chemistry) teaches only in the area of specialization. However upon analyzing various forms of data collected in the course (e.g., exit interviews, science self-story), I realized that the teachers did not have a similar outlook on teaching science as I did. This section will review teacher candidates’ prior knowledge and experiences in the K-16 science classroom as a student and teacher.

Knowledge of teacher candidates’ prior knowledge of teaching science. Background knowledge of what teachers understand about teaching science is important in designing the teaching and learning environment. Elementary teachers’ schema is both holistic and departmentalized. The teacher incorporates the skills and strategies for teaching science within a
larger context of “tools of the trade” (Shulman, 1986) but the subject matter knowledge is seen as separate areas of study (e.g., chemistry).

Elementary teachers think holistically about teaching. As part of my research, I found that teacher candidates vice teachers often discussed the strategies for designing instruction – 5E learning cycle [Engage, Explore, Explain, Evaluate and Elaboration] (Bybee et al., 2006) and the Content Representation (Loughran, Berry, & Mulhall, 2006) – as impacting growth in understanding how to teach. These discussions primarily center on how the strategies would work well in teaching a range of subjects. Few teacher candidates discuss the strategies appropriate for just teaching science in developing an inquiry in the science classroom. Teachers with this vision also had a more developed understanding of the science content. The prevailing vision of the course instructional strategies is to take the ideas of the course to fit into a schema to teach all subjects.

Subject matter knowledge is departmentalized. In a study funded by a UNL interdisciplinary grant, I explored early elementary teachers’ knowledge of teaching properties of matter (in prep) and found that teachers did not connect measurement (e.g., length) to scientific knowledge. The elementary teachers in the study were only able to identify the states of matter – solid, liquid, and gas – with little discussion of what they were. When asked about measurement, the teachers shifted to provide numerous examples and ways in which to teach the material. The teachers shared that the topic was part of the mathematics curriculum, which is an emphasized subject area within local, state and national school tests and accountability programs. The teachers were able to make the connections between the two areas when asked but their initial response may be indicative of teacher candidates’ subject matter knowledge structure as well.

Knowledge about teacher candidates’ experiences teaching science. This knowledge
area aligns with the elementary programs focus to build on the knowledge gained in the university classroom by experiencing it in the elementary classroom. This course does not have a practicum experience included. A typical class will have nearly half of the students concurrently participating in a practicum but this is not always the case. Confounding this is across the state science at the elementary level has begun to be removed from the curriculum. For instance in the local school district, the curriculum allots 10 days of science instruction at 20 minutes per day during a 9-week period.

Prior to entering the course, few teacher candidates, vice teachers have taught or observed a science lesson in a K-6th grade classroom. To build experience with teaching science, the students are asked to design and implement a lesson to a group of children. All students would work with the cooperating teacher to teach a “science” lesson. As little time is allotted to science, many of the lessons focus on health topics (e.g., alcohol and tobacco use), the cooperating teachers would prefer for the teacher candidates to follow the lessons provided (step-by-step experiments and worksheets), and allowed for only 15-minutes or less to implement. For those teacher candidates without a practicum, they often worked with small groups of children – most are family members or children they nanny. Most teacher candidates have had less than ideal settings in which to gain experience in teaching science.

**Concerns Identified as Part of Peer Review of Teaching Project**

The peer review of teaching project had me identify concerns for teaching the elementary methods course. The concerns I wanted to address focused on eliciting teacher candidate’s views and experiences with teaching science as well as my ability to identify evidence of growth. The first area focuses on my needing to understand if I need to develop more instructional strategies
to support teacher candidate growth. This involves both in terms of specific topics for teaching science as well as addressing an integrated view of teaching. The final area is the inability to determine when a response represents growth rather than presenting experiences.

**Concern: Addressing teacher candidates’ orientations and experiences in the science classroom.** This focuses on the teacher candidates prior experiences with science in the formal and informal (e.g., museum) settings. This aligns with the premise behind the elementary education program which is designed to “build meaningful links between your [the students] previous learning experiences and elementary learning environments.” The teacher candidates must be aware of his or her prior experiences in order to make connections to the experiences provided in the course. In order to develop effective instruction, teachers must not only have knowledge of the best practices in teaching but also have the subject matter knowledge to connect the content and recognize children’s alternative conceptions. Prior to the Peer Review of Teaching, I implemented two activities to help the teacher candidates be aware of their prior experiences. However, I had not assessed teacher candidates’ subject matter knowledge.

The course is not focused on subject matter knowledge of science instead focuses on the subject matter knowledge for teaching. In the past, the course had traditional assessments (e.g., quizzes) but the teacher candidates were intimidated by the practice. Teaching science is focused on the processes of science more than discussing facts. I implemented an evaluation of teacher candidate’s comfort of teaching science to bridge the gap.

The first activity asks the teacher candidates to describe the most and least favorite subjects or topics in science on the first day of the course. Teacher candidates enter the course preferring the natural sciences to the physical sciences. Within the Spring TEAC 315 Section 001, 16 of the 20 teacher candidates mentioned natural science topics such as zoology, geology,
solar system and biology. Only three of the teacher candidates mentioned chemistry or physics topics. As a result, the course is designed to primarily explore topics in the physical sciences such as magnets, pendulums, circuits, chromatography and physical properties (see Pictures below).

As a follow-up, this semester I implemented a brief questionnaire to determine if the topics mentioned had shifted to include physical science as well as other concepts as well (see Appendix A). Within the same section, teacher candidates identified a variety of topics they felt more comfortable in teaching as a result of the course experiences. Most teacher candidates selected inquiry, waves, magnets and chromatography as feeling comfortable. This information provides a view of what the course may have supported in a change in view for teaching of science. The data does not specifically provide me a clear indication of the course impact. Take Away: I will implement a similar document at the beginning of the course with my next
section of students to be able to determine a more direct correlation between the course experiences and teacher candidate changes.

The second activity to determine teacher candidates’ views on teaching science is a Science Letter (See Appendix B). The letter is designed as a discussion about the experiences with learning K-16 science and in informal settings (e.g., museum). The Science Letter was created by The majority of the teacher candidates enter the elementary science methods course having had negative experiences with science. For the Spring 2015 Semester, elementary school was a time of positive experiences with science topics and teachers (See Figure 2). The majority reference hatching a chicken from an egg as one of the most vivid and favorite science activities. Middle and high school experiences were reported as negative experiences where the students begin to dislike the subject because of the emphasis on lecture and memorization. In college, the students usually discuss two courses – entomology and a meteorology course – as providing positive experiences. However, there are a number of students that struggle with the lecture format emphasizing memorization. Informal experiences were described as completed with a family member (e.g., mother, father) that had a particular interest in nature or science. Many of the students failed to include a description of an informal experience (No Discussion). Take Away: I need to modify the project to ensure that all students address each level of experience or point out this area when describing Science Letter Project.
Figure 2. TEAC 315 Spring 2015 perception of science experiences.

The Science Letter was to help teacher candidates reflect on their own experiences. As originally written, I had not implemented any project in which to help the teacher candidates recognize what the information meant for them. In the Spring 2013, I visited P. Friedrichsen and D. Hanuscin at the University of Missouri to shadow leading science educators in the field. Hanuscin shared with me her final project for her elementary science methods course that bridged this gap in my course. I recognized the importance of the project was to allow the teacher candidate to confront his or her own views toward science and how the idea shifted across the semester to potentially impact the classroom experiences for children. For example, Erika M illustrates the reflection on teaching science to future teaching endeavors.

Coming into the semester I thought of science lessons as the teacher lecturing about a certain subject and then having students complete a pre-constructed activity. This is the way that most of my schooling was done so coming into this class I thought that that was how we were going to be teaching and learning science. Through the course of this class I
learned a great deal about the central concepts, tools of inquiry, and the structure of
science or what are known as the three legs of science… The learning process
accomplishes more than a traditional science class and I started thinking about how much
students can learn from this type of instruction. (See
https://sites.google.com/site/erikamscience/goal-1)

Take Away: I will continue to engage teacher candidates in similar experiences in order to
help them identify areas that they have grown across the semester.

Concern: How to address an interdisciplinary view of teaching. Elementary teachers
think holistically about teaching. As part of my research, I found that teacher candidates often
discussed the strategies for designing instruction – 5E learning cycle [Engage, Explore, Explain,
Evaluate and Elaboration] (Bybee et al., 2006) and the Content Representation (Loughran et al.,
2006) – as impacting growth in understanding how to teach. These discussions primarily
centered on how the strategies would work well in teaching a range of subjects. Few Teacher
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the teachers shifted to provide numerous examples and ways in which to teach the material. The
teachers shared that the topic was part of the mathematics curriculum, which is an emphasized subject area within local, state and national school tests and accountability programs. The teachers were able to make the connections between the two areas when asked but their initial response may be indicative of teacher candidates’ subject matter knowledge structure as well.

The course originally dedicated only one class during the 16 weeks on interdisciplinary connections. Based on my research findings, I needed to find a way to engage teacher candidates in developing an integrated view of teaching. As a result, I implemented the activities to connect 1) literature to science by collaborating with Lincoln Public Librarians and 2) art and science by implementing the lesson Chromatography Garden (see picture below).
The literature and science lesson involved the teacher candidates to recognize science concepts in books. The teachers were asked to read and identify a variety of science concepts that could be pulled out of a book regardless of the genre. The books were primarily narrative fiction texts that would not be considered as a “science” text. For example, Pickin’ Peas retold by Margaret Read MacDonald was a book about a little girl who is planting peas. The teacher candidate identified science concepts such as plants, animals, survival, and life cycle. This same teacher explained in her reflection about the experience as

This was fun because I honestly didn’t realize how much science there actually is in books. Even though it is a children’s book, you can find some science aspects within the book and come up with a fun activity to engage students even more! Today has made me realize that integrating trade books in science class makes learning more fun. However, you have to pick the right book and make sure it is on grade level. It also allows you to critically think about stories and learn from them. Teacher candidates continued to reference the experiences from the library in their final portfolio projects. For example, another teacher candidate discussed learning how to question the books to determine what and how information was presented (see link). She recognized that books often present information that is not correct and that she “would need to address with my [her] students.” Take Away: I need to continue to incorporate lessons using literature and science. I feel that I need to spend more time focusing on critically analyzing the texts for developing teacher and student scientific literacy. One aspect of science literacy is the ability to critically analyze texts for how science is represented.

Link to website: http://econletscienceportfolio.weebly.com/goal-three.html
Art and science was presented as a project for an elementary classroom. The project used the science concept of chromatography and mixtures through colors. The teacher candidates were not aware that the colors would separate when placed in water. See Appendix C for an example journal entry of the Chromatography garden lesson. I want to highlight her response as she demonstrates that she is describing the activity in terms of both a teacher and student. The student response is: “I think that I would have seen more colors with a thicker marker.” The teacher response is: “This would be a good experiment for elementary students because it is incorporating art in a science lesson.” This allows me to understand that the teacher candidates are learning material as they explore various concepts but also that they are beginning to recognize how these same experiences can impact their future classroom. Take Away: The teacher candidates in this example are not recognizing the integration of science into other areas of learning. I want to highlight this aspect to a greater extent in my future iteration of the course. The project is successful as they are learning about teaching and learning science.

Concern: How to identify teacher candidate growth. The act of teaching involves building meaningful links between previous learning experiences and learning environments to current reform-based instruction. With this understanding, the teacher recognizes the impacts on student learning and if necessary continue to modify instruction to meet student needs. I designed my elementary science methods course to engage teacher candidates in reflection of previous experiences in science, offer teaching opportunities to connect current theories to practice, and assess growth or change in knowledge to recognize impacts on teacher and student learning. I had originally designed my final assessment for Teacher candidates to reflect on their knowledge of instructional strategies and knowledge of students understanding. While the course was designed to focus on more than instructional strategies and student learning, I emphasized
this one aspect in my final assessment. While important for teacher learning, I may have been compensating for my own struggles in learning to teach science. I needed to design a final assessment that aligned with all course goals.

I was introduced to a final project that asked teacher candidates to reflect on their experiences with respect to course goals. The Science Teaching Portfolio (STP) was the missing link for my course as I recognized what I had missed previously. I knew I had been on the right path because my course goals aligned with my framework but seeking support from colleagues allowed me to see an area I needed to address. With the STP, the teacher candidate is asked to describe his or her growth in relation to the evidence – activities, readings and experiences with teaching and learning science. Each teacher candidate enters the course with his or her own unique experiences and ideas about science content and teaching and learning. My goal is to engage the teacher candidate in self-assessment of growth as the STP states, “It provides the basis for self-assessment of your learning, and my evaluation of your progress this semester.” The portfolio allows the teacher candidate to describe his or her path across the semester and recognize how those experiences impact growth and change for teaching science.

The STP emphasizes the teacher candidate’s choice of evidence they deem as important to their own professional growth or change. An exemplary portfolio would include evidence that shows breadth and depth of knowledge that demonstrates strong links to the course goals. This would include detailed multi-experience explanations supporting growth in the knowledge of teaching and learning science. When I scored the first class, I was pleased with the teacher candidate’s responses as I saw how the course impacted their understanding of teaching science. I knew previous Teacher candidates took away similar changes in views of teaching and learning science but had not been able to document the impact. However, I did not evaluate the teacher
candidate’s response with respect to growth and change over the course. I was unable to
distinguish between a portfolio that clearly described growth and change and to one that only
presented activities that impacted the Teacher candidates. This is important to recognize in order
to help the Teacher candidates form the necessary habits and skills of observing, interpretation
and analysis of teaching and learning which supports developing and improving their practice.
They are introduced to the process of analyzing current understandings in light of research and
experience to determine what they “learned” during the course.

The first example, L.P., demonstrates an entry that I would have initially scored well
because it clearly connects the course goals with numerous considerations about students’
learning. Once I understood the purpose of the assessment, I recognized L.P.’s STP entry as an
example of a response that does not address growth or progress over time. Through the CLC
teaching experience, I engaged her in connecting prior knowledge of the students’ personal and
social behaviors and knowledge. Within the entry she references prior experiences with K-2nd
and 4th and 5th grade students as preparing her for the 3rd – 5th grade space science club that she
and her peers taught. She designed the lesson “to be more sophisticated and higher leveled,
because I was working with students who have probably been introduced to the idea of space
before.” From her response, it is clear that she has recognized a number of aspects about
students’ personalities and potential higher abilities for planning the telescope lesson. Her final
statement states, “Through my experience this semester with the CLCs I believe that I met this
goal and can now understand what I can do to help my future students.” However, there is no
evidence to show growth or change but she is clear that she has “met” the goal. Missing from the
discussion is what she knew previously about these children or may have learned from
interacting with these particular students. I need to continue to support her in making clear
growth statements beyond just meeting the course goal.

Brooke’s portfolio represents an example that I would have concerned me because the focus of the entry is on classroom management. Now I recognize the entry is an exemplar response as she discussed numerous learning experiences, referenced where she began, where she is now and what she currently believes a classroom should include. She was impacted by the CLC teaching experience, required reflections, and professional development experience (e.g., zoo). By focusing on the practice of reflection, she began to realize the importance of reflection for teaching as helping her to recognize what did not go well with the lesson and using reflection to “think over the classroom management and use a different teaching strategy. In another example, she discussed the importance of traveling to the local zoo “instead of being a regular spectator, I used the opportunity to see… through the eyes of a teacher.” As a result if she took students to the zoo, she would ask the “zoologist at each exhibit to help them learn more about specific animals” and have students’ draw pictures and record facts in the science journal.

This entry does not demonstrate B.Mc consideration of the students’ needs and designing instruction aligned with the learning cycle. By providing students specific questions to consider on each experience, B.Mc was able to recognize how these skills are necessary for her to continue to think about teaching and learning. As she focused primarily on classroom management, I know that she may need more support in developing reform-based lessons that engage students in learning science. I may also need to ensure that the CLC provides a controlled environment for her to move beyond management concerns. It may also mean she needs more experience in the classroom to feel comfortable to teach children. However, the reflections of the course experiences shows that she has begun recognizing the importance of analyzing the experience to identify what could be changed to support student learning. **Take Away: I need to**
include my course examples that demonstrate the difference between a growth entry and a retelling of events. This practice is essential in teaching as teachers must be able to identify their own understanding in order for them to develop in a particular area. Each person is unique thus will have their own areas for concern in developing as a teacher.

References


### Teacher Candidate Check List

Name _________________________________________________

Do you feel more comfortable with the following topics?

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<tr>
<th>Topic</th>
<th>Check All That Apply</th>
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<td>Electricity</td>
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<td>Waves</td>
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<td>Force</td>
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<td>Animals Characteristics</td>
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<td>Geology</td>
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<td>Fossils</td>
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<td>Inquiry</td>
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<td>Formative &amp; Summative Assessments</td>
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<td>Chromatography</td>
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<td>Student Questions</td>
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<td>Models</td>
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<td>Professional development</td>
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<td>Nature of science</td>
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<td>Journals</td>
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<td>Venn Diagrams</td>
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<td>Concept Maps</td>
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<td>Diverse needs of students</td>
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<td>Rubrics</td>
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<td>Working with children</td>
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<td>Collaborative Writing</td>
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<td>Unit planning</td>
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<td>Modifying lessons</td>
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Appendix B

**Science Letter**

Your grade will be based on the extent to which your letter meets the intent of the assignment, which is reflective analysis and evaluation of your experiences. Though there is not a page requirement, your paper will most likely be about 5-pages in length. Please use 1” margins, 12-point font and double-space.

- Write me a letter, include the following:
  - A little bit about yourself;
  - What attracted you to education (or your current emphasis);
  - Specifically talk about your previous experiences with K-16 science and engineering (both in and out of school) from your earliest memories to the present day; what part of science, if any, are you most interested in; If you don’t remember much about your early science experiences, speculate on the possible reasons.

  - **Reflect:** Once you have described you experiences, reread your work for analysis:
    - What are the general characteristics of science and engineering experiences that have been meaningful (or a turn-off) for you? Do you feel you have been successful in science? Why or why not? Be as candid as possible in responding to these issues.
  
  - **Connect:** Finally, give your definition of science (what you think science is and how you view it) How have your past learning experiences shaped your definition of science and your attitude towards science?
    - What you hope to do after graduation;
    - What you hope to get out of this class;

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<th>Points</th>
<th>Criteria</th>
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<tr>
<td>9-10</td>
<td>The paper is clearly focused, fully addresses the topic in a well-organized manner, and provides ample support through detailed examples and elaboration of ideas. Conventions of writing are followed without error. Reflection is both insightful and articulate.</td>
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<td>7-8</td>
<td>The paper may contain few lapses in writing conventions or statements and ideas that need further elaboration. Evidence of self-assessment and reflection throughout.</td>
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<td>5-6</td>
<td>The paper contains several errors in writing conventions and/or provides imbalanced support and elaboration of ideas. Reporting rather than explaining; Little, if any, self-assessment and reflection.</td>
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<tr>
<td>3-4</td>
<td>The paper focuses on the topic, but may fail to address all areas completely. Lapses in organization occur and support of ideas through examples and elaboration is lacking. Errors in writing conventions occur frequently.</td>
</tr>
<tr>
<td>1-2</td>
<td>The paper does not address the criteria outlined in the procedure above, or the student did not complete the assignment.</td>
</tr>
</tbody>
</table>

Chromatography Garden

3/9/15

What colors do we see in flowers? We see all colors of the rainbow in all different kinds of flowers.

Paper & water: the paper is similar to tissue paper. It is white/cream. The water level will not be above the black line to start.

Prediction: once the water hits the filter, it will travel up the filter. Then once the water hits the black line, the black will transfer upwards.

Observations: once the water hit the black line, the black line dispersed quickly and started to bleed. I see more colors on the coffee filter -> blue, purple, green. I noticed people at my table had different flowers with different colors.
Notes:
• How does the black disappear and create more colors?
• Why do the colors change?
• Is there something about the coffee filter that helped make different colors?

Subject matters: Art and science.

Mixture -> chemistry, black is made up of different colors.

Homogeneous mixture: same throughout.

Reflection: I did not think that you would be able to see different colors in the filter. I thought it would just be black. My experiment was not as colorful compared to others. I noticed mine was a little black, purple, and blue. I think that this happened because the mark was really thin. I think that I would have seen more colors with a thicker marker. This would be a good experiment for elementary students because it is incorporating art in a science lesson. We could talk about how different pens separate colors differently and the coffee filters look different depending on the pen. We could also discuss how chromatography is a form to identify objects...
## Science Teaching Portfolio

**Name:**

**Conference Date/Time:**

<table>
<thead>
<tr>
<th>Analytic Evaluation</th>
<th>Scoring guide:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1: Exemplary 2: Proficient 3: Adequate 4: Unsatisfactory</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Easily navigable, reader-friendly. Table of contents thorough and complete. Professional and neat in appearance with logical sequence evident.</td>
</tr>
<tr>
<td>2</td>
<td>Well-organized and professional in appearance. The table of contents is complete.</td>
</tr>
<tr>
<td>3</td>
<td>Some attempt at organization, but it is difficult for the reader to locate individual portfolio contents easily.</td>
</tr>
<tr>
<td>4</td>
<td>Lacks organizational schema; navigation of portfolio is difficult.</td>
</tr>
<tr>
<td><strong>Quality of Evidence</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Portfolio contains multiple pieces of evidence to support progress toward each goal. The link between course goals and evidence is strong. Diverse, represents both depth and breadth of knowledge. Evidence documents professional growth and change.</td>
</tr>
<tr>
<td>2</td>
<td>Portfolio contains evidence to support progress toward each goal. Evidence relates to each of the course goals. Variety of evidence presented. Professional growth evident throughout portfolio.</td>
</tr>
<tr>
<td>3</td>
<td>Portfolio contains evidence to support progress toward each goal. Evidence is only loosely connected to course goals, or the connection is not made explicit. Professional growth evident in most areas.</td>
</tr>
<tr>
<td>4</td>
<td>Portfolio does not contain evidence to support progress toward each goal. Evidence is not connected to course goals. Growth and progress not evident.</td>
</tr>
<tr>
<td><strong>Teaching Statement</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Articulate; well-developed, logically organized, and clearly expressed. Student indicates a firm commitment to his/her educational philosophy with supportive reasoning. Based on professional, rather than personal knowledge. Reflects an understanding of science teaching and learning, consistent with the overall portfolio and evidence.</td>
</tr>
<tr>
<td>2</td>
<td>Logically organized; beliefs are expressed and supported with examples. Writing reflects an understanding of science teaching and learning, consistent with the overall portfolio and evidence.</td>
</tr>
<tr>
<td>3</td>
<td>Statement is coherent; support is general rather than specific. The student fails to connect beliefs to the portfolio evidence OR his/her beliefs about science teaching and learning are not consistent with the overall portfolio and evidence.</td>
</tr>
<tr>
<td>4</td>
<td>Writing is disorganized and/or reasoning is not presented in a logical sequence. Insufficient depth and elaboration of ideas about science teaching and learning. Written statement does not coincide with portfolio evidence presented.</td>
</tr>
</tbody>
</table>

**Instructor’s Comments:**

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*Modified from D. Hanuscin Fall 2012 Course*