

Young Scientists, Young Engineers: STEM in the Elementary Classroom

Framingham State University
Spring 2018; 1 credit
4 week online course
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Course Description: This course presents current information about elementary engineering and elementary science pedagogy. The coursework draws upon the newly adopted Massachusetts Science Technology and Engineering standards and the nationally used NGSS standards. Particular focus will be placed on the Science and Engineering Practices that span across the grade levels and content areas. Students will develop an understanding of instructional techniques that align with the new standards and work to create young scientists and young engineers out of our elementary school students. Students will create storylines that will engage their young scientists and engineers in the exploration of scientific phenomena. They will also create a final lesson plan that will bring all of these components together in one learning experience.

Objectives:

- Students will demonstrate their understanding of the engineering and science practices by selecting at least two standards that can be combined to teach engineering design and science content simultaneously.
- Students will analyze and critique science classroom instruction in order to determine changes they can make in their own practice.
- Students will develop strategies and collect resources to be able to implement the engineering design process in their classrooms.
- Students will connect science concepts with practices by creating a single scientific storyline.
- Students will design lessons that will engage their elementary students in the design process as well as to further develop their understanding of the content.
- Students will carry out their lessons within the classroom in order to practice their learning.

Required Readings:

Bybee, Rodger W. "Scientific and engineering practices in K-12 classrooms: understanding a framework for K-12 science education." *Science Scope* Dec. 2011: 6. *Academic OneFile*. Web. 15 May 2016.

Lachapelle, Cathy, Kristin Sargianis, and Christine Cunningham. "Engineering Encounters: Engineer It, Learn It: Science and Engineering Practices in Action." *Sci. Child. Science and Children* 051.03 (2013): n. pag. Web.

Lottero-Perdue, Pamela, Sonja Bolotin, Ruth Benyameen, Erin Brock, and Ellen Metzger. "The EDP-5E." *Sci. Child. Science and Children* 053.01 (2015): n. pag. Web.

*All of these articles can be accessed using Blackboard through the FSU Whittemore Library.

Expectations:

Students are expected to be active participants in the classroom discussions, as this work is at the heart of our online course. Students are expected to post a thoughtful response to the discussion questions and then reply to two of their classmates. Students need to access the discussion board a minimum of two times per week so that they can monitor new additions to the chats and look at their classmates' replies to their own posts.

After an understanding of the standards, practices, and pedagogical shifts is created, students will use their understanding to create a science storyline and a lesson plan that incorporates both content and engineering. All assignments should be completed by the last day of each week. Any late assignments will be scored one point lower.

Grading Criteria:

Week #1 Discussion Posts:	10%
Week #2 Discussion Posts:	10%
Week #3 Discussion Posts:	10%
Week #4 Discussion Posts:	10%
Science Storyline:	30%
Lesson Plan:	30%

Post Rubric

1 - Unsatisfactory	2 – Needs Improvement	3 - Satisfactory	4 - Exemplary
Posts are not relevant, not complete, or do not reflect the material assigned.	<ul style="list-style-type: none"> • Posts are limited responses to the questions posed. • Posts reflect limited understanding of the material. • Participant accessed the discussion board 1 time. 	<ul style="list-style-type: none"> • Posts are relevant and thoughtful responses to the questions posed. • Posts reflect understanding of the material. • Participant accessed the discussion board at least 2 times. 	<ul style="list-style-type: none"> • Posts are relevant and thoughtful responses to the questions posed. • Posts reflect understanding of the material. • Posts include reference to the content watched or read. • Participant accessed the discussion board at least 2 times.
Participant posted 0 replies.	Participant posted 1 reply.	Participant posted 2 replies.	<ul style="list-style-type: none"> • Participant posted 2 or more replies. • Responses to others are thoughtful and engage others in an academic conversation.

Science Storyline Rubric

1 - Unsatisfactory	2 – Needs Improvement	3 - Satisfactory	4 - Exemplary
<ul style="list-style-type: none"> • template is missing many components, work is not cohesive and/or is not connected to standards 	<ul style="list-style-type: none"> • incorporates at least 1 science standard • addresses 1 well-crafted and thoughtful question • includes grade appropriate learning activities for each question 	<ul style="list-style-type: none"> • incorporates at least 2 science standards • addresses 2 well-crafted and thoughtful questions • includes grade appropriate learning activities for each question • includes vocabulary within science reasoning 	<ul style="list-style-type: none"> • incorporates at least 2 science standards, including engineering standards if applicable • addresses 2 or more well-crafted and thoughtful questions • includes a variety of grade appropriate learning activities for each question • includes vocabulary within science reasoning

Lesson Plan Rubric

1 - Unsatisfactory	2 – Needs Improvement	3 - Satisfactory	4 - Exemplary
<ul style="list-style-type: none"> • template is missing many components, work is not cohesive and/or is not connected to standards 	<ul style="list-style-type: none"> • follows format but is missing components • incorporates grade level standards • follows the 5E model • contains culminating activities 	<ul style="list-style-type: none"> • follows format and contains all components • incorporates grade level standards in science • follows the 5E model and includes engaging phenomena • contains a culminating engineering challenge 	<ul style="list-style-type: none"> • follows format and contains all components • incorporates grade level standards in science and math • follows the 5E model and includes engaging phenomena • includes evidence of practices appropriate to your grade level • contains a culminating engineering challenge that carefully connects to content

Course Content and Outline:

Week 1: What changes are embedded within the new standards?

Day 1 - 3: Introductions (Make sure you do this within the first three days of the course start date)

Tell us a bit about your teaching background and your current teaching role. In your introduction, include a bit about your current science teaching, your district's implementation of the new standards, or one area of science teaching you are looking to grow in.

Activity 1: Watch course introduction video.

Activity 2: Familiarize yourself with the science standards and select 2-3 standards that you will use as your focus for this course. If your district has a sequence, standards that may be coming up next in your teaching will be most useful. Be sure to look also at the grade before and after you so that you are familiar with where students are coming from and what you are preparing them for.

Massachusetts teachers, use MA STE standards:

<http://www.doe.mass.edu/frameworks/scitech/2016-04.pdf>

Out of state teachers, use NGSS standards:

<http://www.nextgenscience.org/>

Answer the discussion questions on the Blackboard Discussion Board. Reply to at least one of your classmate's responses.

Activity 3: Read the article,

http://nstahosted.org/pdfs/ngss/resources/201112_framework-bybee.pdf

Answer the discussion questions on the Blackboard Discussion Board. Reply to at least one of your classmate's responses.

Week 2: Practices in Action

Activity 1: Watch week 2 video.

Activity 2: Watch classroom videos.

PK-2 Teachers

<http://www.sciencepracticesleadership.com/video---grade-2.html>

<https://www.teachingchannel.org/videos/first-grade-science>

<https://www.youtube.com/watch?v=N1sb9tzwOd8>

3-5 Teachers

<https://psu.app.box.com/s/n8skoxuimt2oqfif6moj>

<https://psu.app.box.com/s/jp91urkrmzelzi0hxp4a>

<https://www.teachingchannel.org/videos/teaching-stem-strategies>

Answer the discussion questions on the Blackboard Discussion Board. Reply to at least one of your classmate's responses.

Activity 3:

Download and read "Instructional Strategies for Science Practices" from

<http://www.sciencepracticesleadership.com/instruction-tools.html>

Answer the discussion questions on the Blackboard Discussion Board. Reply to at least one of your classmate's responses.

Week 3: A Possible Model to Use

Activity 1: Watch week 3 video.

Activity 2: Watch the video and read the article.

http://libraries.state.ma.us/login?gwurl=http://go.galegroup.com/ps/i.do?id=GALE|A427665835&v=2.1&u=mlin_m_minute_man&it=r&p=AONE&sw=w&asid=c15220ae027f2d4ff380028fed3ece89

<http://www.bioedonline.org/videos/supplemental-videos/5e-model-for-teaching-inquiry-science/>

Answer the discussion questions on the Blackboard Discussion Board. Reply to at least one of your classmate's responses.

Activity 3:

Read article about engineering.

<http://search.ebscohost.com.fscproxy.framingham.edu/login.aspx?direct=true&db=ofs&AN=91710125&site=ehost-live>

Watch the following video:

<https://www.youtube.com/watch?v=8AGO8ZgBMnA>

If you are unfamiliar with engineering design process, familiarize yourself with one example of the engineering design process.

<https://www.teachengineering.org/k12engineering/designprocess>

Answer the discussion questions on the Blackboard Discussion Board. Reply to at least one of your classmate's responses.

Week 4: Pulling it Together – Engagement and Inquiry

Activity 1: Watch week 4 video.

Activity 2:

<https://www.teachingchannel.org/videos/using-phenomena-achieve>

Answer the discussion questions on the Blackboard Discussion Board. Reply to at least two of your classmate's responses.

Final Assignments: Let's bring it all together. Use all course readings and videos to support your crafting of two documents. The first is a science story outline that must include the standards you have been using as a frame for the course, as well as the engineering and science practices. Second, select a portion of the science story to draft into a complete lesson plan. Use the provided templates to prepare this work and use the rubrics to understand the expectations of the assignment.

Questions:

Please contact me at drobillard@framingham.edu or 413-210-5807. I will reply back to you within 24-48 hours.

Academic Honesty Policy:

Integrity is essential to academic life. Consequently, students who enroll at Framingham State University agree to maintain high standards of academic honesty and scholarly practice. They shall be responsible for familiarizing themselves with the published policies and procedures regarding academic honesty. Academic honesty requires but is not limited to the following practices: appropriately citing all published and unpublished sources, whether quoted, paraphrased, or otherwise expressed, in all of the student's oral and written, technical and artistic work; and observing the policies regarding the use of technical facilities.

Taken from the Framingham State University Graduate Catalog, Student Conduct page 21.

Academic Accommodations Policy:

Framingham State University offers equal opportunities to all qualified students, including those with disabilities and impairments. The University is committed to making reasonable accommodations as are necessary to ensure that its programs and activities do not discriminate, or have the effect of discriminating, on the basis of disability. Academic Success serves students with learning and psychiatric disabilities as well as students with visual, mobility and hearing impairments.

Academic Success works to provide reasonable accommodations to qualified students. The purpose of accommodations, modification, and/or auxiliary aids is to reduce or eliminate any disadvantages that may exist because of a disability. Framingham State University is not mandated by law to waive specific courses or academic requirements considered essential to a particular program or degree. Rather, the University is mandated to modify existing requirements on a case-by-case basis in order to ensure that individuals are not discriminated against on the basis of their disability.

Additional Resources/ Supplemental Material:

<http://www.nextgenscience.org/sites/default/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf>

<http://stemteachingtools.org/tools>

<http://tryengineering.org/>

<http://bie.org/>

<https://www.teachengineering.org/>

<http://betterlesson.com/home>

<http://ngss.nsta.org/Classroom-Resources.aspx>

<http://learningcenter.nsta.org/>

<https://mysteryscience.com/>

http://www.pbslearningmedia.org/search/?q=&selected_facets=grades_exact%3A4&selected_facets=supplemental_curriculum_hierarchy_nodes%3A1&selected_facets=

<http://ambitiousscience.com/>

<http://concord.org/stem-resources/grade-level/elementary-school>

<http://eie.org/nextgensnippets>

<http://www.nsta.org/elementaryschool/connections.aspx#1509>

<http://www.nextgenstorylines.org>

Final Project Templates

Science Storyline

Teacher:

Title of Unit:

Grade Level:

Standards (include the number and the description):

Question	Claim	Evidence	Reasoning	Learning Activities

NGSS Lesson Planning Template (adapted from Lewis Center for Educational Research)

Teacher Name:

Grade:	Topic:	Lesson # _____ in a series of _____ lessons (this can be a work in progress, just estimate)
Brief Lesson Description:		
Performance Expectation(s):		
Specific Learning Outcomes:		
Narrative / Background Information		
Prior Student Knowledge (refer to standards from previous grades):		
Science & Engineering Practices:		
Possible Preconceptions/Misconceptions:		
LESSON PLAN – 5-E Model		
ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:		
EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions (could be engineering):		
EXPLAIN: Concepts Explained and Vocabulary Defined:		
Vocabulary:		
ELABORATE: Applications and Extensions:		
EVALUATE:		
Formative Monitoring (Questioning / Discussion/Scientists Meeting):		
Summative Assessment (Journal Entry/Reflection/Quiz / Project / Report):		
Elaborate Further / Reflect: Enrichment (could be Engineering Challenge):		
Materials Needed:		