UNIVERSITY OF CALIFORNIA, MERCED
EDUC X408 – Project-Based Physical Science for the K-8 Classroom (3 credits)

Fall 2017

Instructor: Lynn C. Reimer
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Office Hours: After class or by appointment

Class location: Merced County Office of Education (MCOE)

Class Date/Time(s): 4 Saturdays (8:00 a.m. – 4:00 p.m.);
4 Thursdays (4:30 p.m. – 8:00 p.m.)

I. Course Description: EDUC X408 provides an opportunity for educators to develop new teaching strategies and curriculum in STEM (science, technology, engineering, and math) with a focus on the Physical Sciences guided by the Next Generation Science Standards (NGSS) and their integration with the California Common Core State Standards (CCSS) for both Mathematics and English Language Arts and Literacy in History/Social Science, Science, and technical Subjects. The readings and simulations focus on the content. The class sessions focus on application of the content to facilitate lesson design and implementation.

II. Course Goals and Outcomes:

a. ***Course Goals:***
The overall goal of this course is to provide course participants (both in-service and pre-service teachers) the opportunity to develop a deeper understanding and mastery of the physical science concepts embedded in the Next Generation Science Standards and how to integrate those with the California Common Core State Standards (CCSS).
This course facilitates collaboration among course participants (teachers) to foster creativity and critical thinking.
This course enables course participants (teachers) to develop both curriculum and associated instructional strategies that promote deeper conceptual understanding and foster a culture of discovery and inquiry learning within their classrooms.

b. ***Learning Outcomes:***
By successfully completing this course, course participants (teachers) will be able to:
   i. Prepare effective lesson plans, activities, and corresponding assessments aligned with the California Common Core State Standards (CCSS) and the Next Generation Science Standards.
   ii. Articulate a variety of instructional strategies to facilitate the following for their students: communication, collaboration, critical thinking, and creativity.

iii. Explain (and apply), in grade appropriate language, the eight science and engineering practices:
    1. Asking questions (for science) and defining problems (for engineering)
    2. Developing and using models
    3. Planning and carrying out investigations
    4. Analyzing and interpreting data
    5. Using mathematics and computational thinking
    6. Constructing explanations (for science) and designing solutions (for engineering)
    7. Engaging in argument from evidence
    8. Obtaining, evaluating, and communicating information

iv. Explain (and predict), in grade appropriate language, interactions between objects and within systems of objects and what underlying forces explain the interactions (the types and magnitudes of forces and the related stability or change that occurs).
v. Explain, in grade appropriate language, how particles combine to form the variety of matter one observes and how substances combine or change to make new substances, including the ability to characterize and predict reactions.
vi. Explain, in grade appropriate language, how energy is transferred and conserved, how forces are related to energy, and how chemical processes are related to energy.
vii. Explain, in grade appropriate language, the characteristic properties and behaviors of waves.

This course is part of University Extension's Education Programs, which focuses on professional development for in-service and pre-service teachers and specifically addresses PLO #1, 4, 5, and 6.

Project-Based Math and Science Program. Learning Outcomes

The overarching goal of the **Project-Based Math and Science Program.** within University Extension's Education Programs is to foster a deeper understanding and mastery of the following: physical sciences, life sciences, earth and space sciences, and the associated mathematical concepts. Those who complete the program. will become effective problem-solvers, model effective problem-solving for their students, and provide opportunities for their students to develop as problem-solvers by fostering communication, collaboration, critical thinking, and creativity in their classrooms.

Students who complete the program. will be able to:

1. Explain, in grade appropriate language, their understanding of matter, motion, energy, and waves.

2. Explain, in grade appropriate language, their understanding of the dynamic structures, processes, and systems of living things.
3. Explain, in grade appropriate language, their understanding of Earth's systems, place in the universe, and the impact of human activity.
4. Integrate science and math across the content areas by applying scientific and engineering practices[1:]
   a. Asking questions (for science) and defining problems (for engineering)
   b. Developing and using models
   c. Planning and carrying out investigations
   d. Analyzing and interpreting data
   e. Using mathematics and computational thinking
   f. Constructing explanations (for science) and designing solutions (for engineering)
   g. Engaging in argument from evidence
   h. Obtaining, evaluating, and communicating information
5. Demonstrate best practices for mathematics and science teaching by applying the following crosscutting concepts in the design and implementation of instruction[1]:
   a. Patterns
   b. Cause and effect: Mechanism and explanation
   c. Scale, proportion, and quantity
   d. Systems and system models
   e. Energy and matter: Flows, cycles, and conservation
   f. Structure and function
   g. Stability and change
6. Use problem-solving skills strategically to solve real-world problems through the creation of lessons that teach, encourage and assess these same skills in their students.

III. Format and Procedures: This course will have online, in-class and classroom application components. The online portion will include readings, simulations, and research. The in-class portion will include lecture, discussion, and in-class exercises. The classroom application portion will include field-testing newly developed curriculum and instructional strategies, which are then analyzed and revised.

IV. Course Requirements:

a. *Class attendance and participation policy*: The course participants (teachers) are expected to be present at ALL sessions for a total of 45 hours. One Thursday session will be online.
b. *Course readings*: Course participants (teachers) are expected to complete ALL readings, simulations, and research for a total of 45 hours.
c. *Course assignments and projects*: Course participants (teachers) are expected to design, implement, and reflect on lessons that cover the topics included in the five units for a total of 45 hours.

V. Grading Procedures:

Both letter grading and pass-fail options will be available. For grading on a pass-fail basis, 70% is considered a passing grade. The course grade will be calculated as follows:

Class attendance and participation, including writings and discussions	40%
Readings, simulations, and research	20%
Lesson Design, Implementation, and Reflection	40%
Total	**100%**

Letter grades will be assigned as follows:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

VI. Academic Integrity:

Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work. Students are encouraged to study together and to discuss information and concepts covered in the course with other students. Students can give "consulting" help to or receive "consulting" help from each other. However, this permissible cooperation should never involve one student taking credit for work done by someone else. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.

VII. Accommodations for Students with Disabilities: The University of California, Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. The instructor is available to discuss appropriate academic accommodations that may be required for a student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester (or equivalent), except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.

Units and Assigned Reading

Unit	Focus	Topics covered	Key assignments
1	Engineering, Technology, and Applications of Science	Engineering Design Links among Engineering, Technology, Science and Society Environmental Engineering and Literacy	Reading Writing (Science Notebook) Discussion Lesson Design Lesson Implementation Lesson Reflection

2	Forces and Motion	Types of Interactions Types and Magnitude of Forces	Reading Writing (Science Notebook) Discussion Lesson Design Lesson Implementation Lesson Reflection
3	Matter	Structure and Properties of Matter Chemical Reactions Types of Interactions Organization for Matter and Energy Flow in Organisms	Reading Writing (Science Notebook) Discussion Lesson Design Lesson Implementation Lesson Reflection
4	Energy	Conservation of Energy Energy transfer Relationship between Energy and Matter Relationship between Energy and Motion Energy in Chemical Processes	Reading Writing (Science Notebook) Discussion Lesson Design Lesson Implementation Lesson Reflection
5	Waves	Wave Properties Electromagnetic Radiation Information Technologies and Instrumentation	Reading Writing (Science Notebook) Discussion Lesson Design Lesson Implementation Lesson Reflection

VIII. Tentative Weekly Schedule: This workshop-style course will vary in time of day, hours per day, and frequency of meetings. Per university policy, 45 hours of class time and 90 hours of out-of-class assignments are required.

Saturday, October 21, 2017 8:00 a.m. – 4:00 p.m.
Thursday, October 26, 2017 4:30 p.m. – 8:00 p.m.
Saturday, November 4, 2017 8:00 a.m. – 4:00 p.m.
Thursday, November 9, 2017 4:30 p.m. – 8:00 p.m.
Saturday, November 18, 2017 8:00 a.m. – 4:00 p.m.
Thursday, November 30, 2017 4:30 p.m. – 8:00 p.m. → This session is online
Saturday, December 9, 2017 8:00 a.m. – 4:00 p.m.
Thursday, December 14, 2017 4:30 p.m. – 8:00 p.m.

References

1. National Research Council. (2012). A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Committee on a Conceptual Framework for New K-12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.