ELED 560 Special Topics: Teaching Engineering in Grades preK-8

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Course Description:
In this course, teachers will learn how engineering affects all that we do in our daily lives, from the complex technologies of electronics and water delivery systems to the simple technologies of our plates, shoes, furniture, and all human-made items around us. In order to create these technologies, engineers use the Engineer Design Process to help them plan, design, test, and improve products and processes. Teachers will learn the Engineering Design Process and develop engineering lessons to implement the design process with their preK-8th grade students.

Course Goals:
The course goals are written as essential questions, with the expectation that teachers will be able to answer these questions with detail by the time the course is finished.
1. What is engineering? What is the relevance of engineering to everyday life?
2. What is the Engineering Design Process?
3. How can the Engineering Design Process be implemented in a preK-8 classroom?

Course Learning Outcomes:
1. After taking pictures of human-made objects (technologies) in the world around them, teachers will be able to describe the goals of an engineer.
2. After examining feats of engineering and learning about the Engineering Design Process (EDP), teachers will be able to describe the steps of the EDP in relation to items in the world around them.
3. Using their current curriculum expectations and/or the most up-to-date state/national science standards, teachers will be able to design an engineering lesson that implements the Engineering Design Process (with possible connections to current science curriculum that they also teach).

Required Course Materials:
Access to Moodle at http://moodle.bridgew.edu is required. You will log in with your BSU username and password. You should already be auto-enrolled in this course. All other course materials will be accessible on our Moodle site via instructor posts or websites.
Outline of Course Topics:
All modules will open and close on the dates indicated below. You may progress at your own pace during the dates each module is open. However, some assignments require you to respond to classmates’ posts, so if you are working faster than others you may have to check back to fulfill some assignment details. It is highly recommended that you wait to receive your grade on each major assignment before completing the next major assignment. More information about each item described below will be on Moodle when the module opens.

Introduction: (July 7-9)
What is your background? (and practice using Moodle)
1. Introduce Yourself: Teachers will log into Moodle and post information about themselves, including name, school and district, grade level teaching, and experience with engineering.
   a. participation points = 3 points

Module One: (July 7-16)
What is engineering? What is the relevance of engineering to everyday life?
1. Video Introduction: Teachers will watch a series of online videos that define engineering and profile the work of engineers.
   a. online discussion = 6 points (2 posts x 3 points each)
2. Engineering in K-12 Education: Teachers will read Chapter 2 in this document from the National Academy of Engineering and the National Research Council.
   a. online discussion = 6 points (2 posts x 3 points each)
3. What is Engineering? and What is Technology?: Teachers will independently take each of the tests and compare their scores to the answer key. Teachers will submit a paragraph reflection for each test detailing the number of answers correct and incorrect, which questions or types of questions posed the most problems and why, and which questions or types of question they were confident in answering and why.
   a. participation points = 6 points (2 test reflections x 3 points each)

Major Assignment One: After taking pictures of human-made objects (technologies) in the world around them, teachers will be able to describe the goals of an engineer. (19 points)
   a. Choose 2 items to describe. The items must be something that you would not have considered technology or made by engineers before this module (e.g. no electronics, phones, appliances, etc.). The items cannot be on either of the tests taken. (2 items x 1 point each = 2 points)
   b. Choose one object from the home. Choose one object from the neighborhood, town, city, etc. Post a picture of each item and its location. (2 items x 1 point each = 2 points)
   c. For each item, describe how and why the item is a technology and/or the result of engineering. References to videos and readings to support reasons are needed to earn maximum points. (2 items x 3 points each = 6 points)
d. Name the type of engineer that would have made each item and describe why you believe this is the type of engineer that would have made it. (2 items x 3 points each = 6 points)

e. Provide a list of all resources used for research. Include title, author, date, and website. (3 points)

**Module Two: (July 16-27)**

**What is the Engineering Design Process?**

1. Engineering Design Process: Teachers will read online and posted descriptions of varying processes used by teachers and engineers that describe the steps engineers take to design technologies.
   a. online discussion = 6 points (2 posts x 3 points each)

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3. Engineering Design Process in Your Classroom: Teachers will determine which words to describe the engineering design process are suitable for their classroom, and create a visually appealing graphic with words and pictures that can be presented to their students.
   a. participation points = 6 points (3 points for design process + 3 points for visuals)

**Major Assignment Two:** After examining feats of engineering and learning about the Engineering Design Process (EDP), teachers will be able to describe the steps of the EDP in relation to an item in the world around them. (15 points)

a. Choose one of the items/technologies from Major Assignment One that you wrote about. With this item/technology in mind, research its evolution/change over time. When was it created? What human need did it fulfill? Who created it? What type of engineer did or would have created it? How do you know? What has changed about it over time? Why have these changes occurred? (6 points)

b. Using the Engineering Design Process that you created for your students, describe what the engineer would have done in each of the steps to create the technology you are describing. Be sure to use supporting research as necessary to provide as much real detail as possible; however, if no real detail can be found, a believable imaginative version is fine. (6 points)

c. Provide a list of all resources used for research. Include title, author, date, and website. (3 points)

**Module Three: (July 27 – August 8)**

**How can the Engineering Design Process be implemented in a preK-8 classroom?**

1. Example Engineering Lessons: Teachers will read and watch short video clips of engineering lessons taught to students of varying grade levels.
   a. online discussion = 6 points (2 posts x 3 points each)
2. Engineering Standards: Teachers will read Chapter 8 of *A Framework for K-12 Science Education* and the revised Massachusetts grade level standards for engineering and technology.
   a. online discussion = 6 points (2 posts x 3 points each)

3. Engineering Lesson Critique: Teachers will read and critique an engineering lesson by answering questions posted online and responding to classmates’ critiques.
   a. participation points = 6 points (2 posts x 3 points each)

**Major Assignment Three:** Using their current curriculum expectations and/or the most up-to-date state/national science standards, teachers will be able to design an engineering lesson that implements the Engineering Design Process (with possible connections to current science curriculum that they also teach). (17 points)
   a. Using the Engineering Design Process (EDP) you created for your students in Major Assignment Two, you will write a lesson plan that outlines how you will implement your EDP in an engineering lesson appropriate for your grade level. Your lesson plan should contain the following details:
      a. title of lesson and how many days it will take to accomplish (1 point)
      b. lesson goal/objective, written as “Students will be able to...” (1 point)
      c. new state engineering/technology standard(s) that your lesson teaches (1 point)
      d. outline of the steps of your EDP and the specific procedures you and your students will take to accomplish the steps (6 points)
      e. list of resources used for planning and researching as you write the lesson (include title, author, date, and website) (3 points)
      f. list of resources (e.g. media, books, pictures, websites) that might be relevant to share with students that are directly related to this lesson (include title, author, date, and website as relevant) (optional: 1 bonus point)
      g. list of materials (1 point)
      h. description of the type of engineer your students will be in this lesson (1 point)
      i. brainstorm a list of things that students will need extra help with or that they may not understand, along with how you’ll support English language learners and/or special education students in your class (3 points)
      j. provide connections to science content you already teach (optional: 1 bonus point)

**Grading:**
Grading is on a 3 point scale when possible. Anything that is worth 3 or 6 points above, please refer to these guidelines:

3/3 or 6/6 = meets expectations by providing thorough, thoughtful, and relevant responses that clearly connect to content read, watched, and learned
2/3 or 4/6 = developing competence due to vague details or loose connections to content read, watched, and/or learned
1/3 or 2/6 = below expectations due to incomplete or irrelevant responses or few to no connections to content read, watched, or learned
0 = missing a required entry
Anything in an assignment that is worth 1 point means you receive a point for the assignment item being present and correct, or 0 points if the assignment item is missing or incorrect.

Grades will be posted in the Moodle gradebook as assignments are scored. The points you earn for the course will be totaled and a percent will be determined. Overall, your total percentage will indicate the letter grade you will receive for the class:

<table>
<thead>
<tr>
<th>Percentage Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>100% - 94%</td>
<td>A</td>
</tr>
<tr>
<td>&lt;94% - 90%</td>
<td>A-</td>
</tr>
<tr>
<td>&lt;90% - 87%</td>
<td>B+</td>
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<tr>
<td>&lt;87% - 83%</td>
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<td>&lt;73% - 70%</td>
<td>C-</td>
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<tr>
<td>&lt;70%</td>
<td>F</td>
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Overall percentages may be rounded up if it falls above the .5 range. For example, a final percentage of 89.6 may be rounded up to a 90% and the student would receive an A- course grade.

**Academic Integrity:**

At Bridgewater State University, academic integrity is expected of every community member in all endeavors. Academic integrity includes a commitment to the values of honesty, trustworthiness, fairness, and respect. These values are essential to the overall success of an academic society. In addition, each member of the university community has a right to expect the highest standards of academic integrity from all other community members. Academic integrity is violated by any dishonest act which is committed in an academic context including, but not limited to: plagiarism; fabrication, falsification, or misrepresentation of data, results, or sources for papers or reports; copying from another student's work; actions that destroy or alter the work of another student; and unauthorized cooperation in completing assignments or examinations.

The culture of K-12 education in the United States encourages teachers to share materials with each other, and to adopt and adapt commercially published materials for their particular teaching contexts. It may be quite appropriate, therefore, for you to use activities, handouts, and/or lesson plans that you obtained from a mentor teacher, found on the Internet, or developed with another teacher. At the same time, units, lesson plans, and curriculum materials are products used in many College of Education courses, including this one, to gauge your individual mastery of concepts and skills central to your success in the profession. Consequently, you are expected to cite sources, including personal communication or professional development workshops, for any materials in those assignments that you did not create on your own. Please ask me if you have questions about how to do this accurately.