RUTGERS
Graduate School of Education

Learning and Teaching
Graduate School of Education
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Topics in Engineering Education
15:256:593 Section D1
Summer 2021
3 Credits

Instructor Name: Debbie Andres, Ed.M.	*Email address*: dsa71@rutgers.edu
Phone Number: (201) 600-6745	*Location*: Online (Zoom) Class Meeting Times: 06/28/2021 – 7/23/2021 M-Th 10:00am – 12:55pm
Office Hours: By appointment	*Prerequisites or other limitations*: Background in physics, physical science, or engineering
Mode of Instruction: ___ Lecture _X_ Seminar ___ Hybrid ___ Online ___ Other	*Permission required*: _X_ No __ Yes

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: https://ods.rutgers.edu/students/documentation-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the registration form (https://webapps.rutgers.edu/student-ods/forms/registration).

Learning Goals:

1. Be able to define and relate different types of engineering to **high school level physics/chemistry curricula**.
2. Understand the process of engineering and how it relates to the **Investigative Science Learning Environment Cycle** (ISLE cycle).
3. Understand expectations for engineering-based learning in high school science classrooms under the **Next Generation Science Standards** (NGSS).
4. Develop **real lesson plans** for a high school physics/chemistry classroom that incorporates engineering-based activities and projects.
5. View and practice **standards-referenced assessment, feedback, and grading** in real context.

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New Jersey Professional Standards for Teachers (2014)[1]

- Standard One: Learner Development
- Standard Two: Learning Differences
- Standard Three: Learning Environments
- Standard Four: Content Knowledge
- Standard Five: Application of Content
- Standard Six: Assessment
- Standard Seven: Planning for Instruction
- Standard Eight: Instructional Strategies
- Standard Nine: Professional Learning
- Standard Ten: Leadership and Collaboration
- Standard Eleven: Ethical Practice

[1] http://www.state.nj.us/education/code/current/title6a/chap9.pdf

Council for the Accreditation of Educational Professionals (2013)[2]

- Standard 1: CONTENT AND PEDAGOGICAL KNOWLEDGE
- Standard 3: CANDIDATE QUALITY, RECRUITMENT, AND SELECTIVITY
- Standard 4: PROGRAM IMPACT
- Standard 5: PROVIDER QUALITY ASSURANCE AND CONTINUOUS IMPROVEMENT

[2] http://caepnet.files.wordpress.com/2013/09/final_board_approved1.pdf

Course catalog description:

This course will afford pre-service and practicing teachers the opportunity to learn about engineering education in the science classroom through hands-on and minds-on investigations and link to their future classrooms through lesson development. By the end of the course, each participant should be able to give a sophisticated definition of engineering, give examples of how to apply physics/chemistry content knowledge to engineering applications, and identify various ways to infuse engineering into the physics/chemistry high school curriculum.

Materials/Resources:

All reading resources will be available on the online learning management system: Canvas. Most materials for class projects will be provided. If materials need to be supplied by the student, they will be notified at least one week ahead of time.

Assignments:

Assessment in this course will be a mix of in-class engineering design projects, written homework, research shadow reflections, written lesson plans, and final exam. All assessments will be scored using a **standards-based assessment** approach.

Lesson Plans

- Teacher Name
- Title of lesson
- Date of lesson (date the lesson plan is due)
- Physics Unit/Topic (that the lesson fits in)
- Lesson Objective/NGSS Performance Expectation
- NGSS Standards (SEP, DCI, and CCC)
- Lesson Description (content of the lesson)

    - Include time intervals for each activity to estimate length of lesson
    - Indicate placement of and type of formative assessments planned
    - Indicate where activities are differentiated and how
    - Include common modifications made for students with specific needs
- Homework assigned (if applicable)

Please type up lesson plans as a Google Doc so that when you submit them through Google, I can give direct feedback and suggestions for each lesson plan.

Final Exam

Final exam will be a lesson plan implemented in our class in the last week of the course. The teacher(s) must come prepared with a lesson plan for a 45 min – 1 hour long lesson along with any materials necessary for the engineering design project. The teacher(s) will lead the class in their lesson and be evaluated on their preparation and implementation.

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Grading policy:

In this course you will be learning how to use standard-based assessment & grading first-hand by designing lessons and assessments, and being graded for the course with this system.

Below you will find some important tools for understanding how you will be graded and the overall concept of standards-based assessment & grading.

Overview

Rather than assigning points to an assignment, each assignment is broken down by skills and/or understandings (standards) that are necessary for success in the task. Each standard is given a score, and all scores for a particular standard are averaged. This will give the student a more detailed view of their understanding by standard, rather than a generic number for everything as a whole.

Standards

Professional Expectations	**Science and Engineering Practices**	**Lesson Planning and Implementation**
Professional Expectations delimit aspects of a successful person in their working and personal lives, setting levels of excellence and integrity in professional situations.	*Science and Engineering Practices describe what scientists do to investigate the natural world and what engineers do to design and build systems to solve problems.*	*Lesson planning and implementation are key aspects of professional practice as a teacher. Teachers should be able to plan with student conceptions, limitations, and content in mind.*

Standard Assessment Scale

Mastery Level		Level Descriptor	Translation
Missing	**0**	I did not hand in the assignment or skipped a portion of the assignment related to this standard.	"I didn't hand in anything."
Page (Emerging)	**1**	I need significant help to improve my understanding of this standard. My current attempts do not show a solid understanding of the assignment or content assessed.	"I put something down but had no idea what I was doing."
Squire (Developing)	**2**	I am starting to understand this standard and need to work to improve my performance because my current work shows many errors or indicates a lack in proficiency.	"I knew what I was supposed to be doing but I didn't know how to do it."
Knight (Demonstrating)	**3**	I am proficient in this standard and meet the basic criteria for understanding but still make some mistakes or show a lack of complete and in-depth understanding.	"I really understand this but I still make small errors and/or don't show all my work."
Scarlet Knight (Refining) 	**4**	I excel at this standard and go above and beyond what the standard requires or to a level of depth that exceeds the norm.	"I was in Beast Mode when doing this. I killed it. Perfect. Done." *drops mic*

"The whole world of science is nothing more than a refinement of every day thinking."

- Albert Einstein

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Grade Calculation

Each standard is assessed multiple times and all scores for each standard are averaged.

Academic Integrity Policy:

Academic integrity: Make sure that you provide proper citations for all materials that you use in all written work. Any violation of academic honesty is a serious offense and is therefore subject to an appropriate penalty. Refer to http://academicintegrity.rutgers.edu/ for a full explanation of policies.

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Course Schedule

Week	Topics to be covered	Assignments & Readings

1st Week	• Next Generation Science Standards
	• Standards-Based Assessment & Grading
	• Differentiation
	• Engineering Design Projects
	  • Bridges
	  • Rube Goldberg Machine
		Due 6/30
		• Readings: "Seven Reasons for SBG" and "Advanced Engineering Education in P-12"

2nd Week	• Engineering Design Process & ISLE
	• Simulations vs. Equipment
	• Interdisciplinary Projects
	• Engineering Design Projects
	  • Race Cars
	  • Low-Impact Devices
	  • Engineering for social change
		To be announced.

3rd Week	• Lesson Planning & Assessment-Building
	• Student-led & Need-based Engineering
	• Engineering Design Projects
	  • Solar Ovens
	  • Renewable Resources
		To be announced.

4th Week	Final Exam Week	