Learning and Teaching
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Rutgers, The State University of New Jersey

Research Internship In Science Education: Engineering Education

15:256:592 Section J1 - 3 Credits

Syllabus - Summer 2016

July 25th – August 17th, 2016
Mondays, Tuesdays, Wednesdays & Thursdays 5:00 – 7:45pm
Room 211, Graduate School of Education, College Avenue Campus

Instructor - Mr. Tovi Spero, Ed.M.	tovspero@scarletmail.rutgers.edu
Office Hours - by appointment	Prerequisites or other limitations - Background in physics, physical science, or engineering.
Mode of Instruction - Seminar	Permission Required - No

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 documentations: https://ods.rutgers.edu/students/documentation-guidelines.

If the documentation supports your request for reasonable accommodations, your campus' 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 on the ODS web site at: https://ods.rutgers.edu/students/registration-form.

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.

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.

Attendance Policy

Attendance to every class is required. Absence/lateness is only accepted with a valid excuse.

Reading Materials

1. Next Generation Science Standards
2. Select articles published in peer-reviewed journals and conference proceedings

Online Resources

Google Classroom
Class Code u1rn9d0

Academic Integrity Policy

Any violation of academic honesty is a serious offense and is therefore subject to an appropriate penalty. Refer to http://academicintegrity.rutgers.edu/integrity.shtml for a full explanation of policies.

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

Assessments

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 (that the lesson fits in)
- Lesson Objective/NGSS Performance Expectation
- NGSS Standards
- 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 via Google Classroom I can give direct feedback and suggestions for each lesson plan.

Literature Review

Select articles from peer-reviewed journals and conference proceedings will introduce students to engineering education. Topics will relate to the P-12 classroom and focus on professional development and student learning. All pre-service teachers must read each assigned article and be prepared to engage in meaningful discussion.

Articles will be distributed online (via Google Classroom) and in person.

All will be responsible for facilitating class discussion on a select article, which includes composing a concise summary and preparing a list of 5 to 10 discussion questions for the class.

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.

Standards-referenced Assessment, Feedback, and Grading

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.

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	**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	**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	**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	**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*

Standards

Professional Expectations

General Standards
Professional expectations go beyond science and engineering and even beyond the professional world; they are about intra- and inter-personal skills are an important part of adult life. All of us strive to be self-motivated in our pursuits, whether they be for pleasure or necessity. We also aim to cultivate good relationships with our peers and superiors because in life you never work or live completely alone. And part of being a self-aware person is to be introspective about what you think and why you think it. We should all seek to be mindful of how we plan, act, and react with others.

I am responsible, resourceful, and flexible **self-directed learner** in my conduct inside and outside of class. I show grit in my work ethic and the drive to learn above and beyond the basic minimum required of class.	SDL
As a **collaborative team member** I use effective interpersonal and leadership skills to manage myself and others as a part of a collaborative effort. I cooperate with my peers and superiors and can follow directions as well as act independently when necessary.	CTM
As a **metacognitive thinker** I think critically when self-reflecting or evaluating my peers. I use reflection and evaluation as an active part of my education and as a way of bettering my understanding of how I think and learn.	MeT

Science and Engineering Practices

Student Standards
Science and engineering practices are the skills and tools used to develop, test, and apply scientific understanding about the universe to our everyday lives. As a teacher, adult, and global citizen you should be able to take in information from your surroundings and abstract concepts from them. You should be able to test your's and others' assumptions about what happens around you and make informed decision based on those assumptions. You should be able to understand what other people say to you, argue your understanding, and communicate effectively based on evidence.

Asking questions (for science) and defining problems (for engineering)	QuP
Developing and using models	Mod
Planning and carrying out investigations	Inv
Analyzing and interpreting data	AnD

Using mathematics and computational thinking	MaC
Constructing explanations (for science) and designing solutions (for engineering)	ExD
Engaging in argument from evidence	EnA
Obtaining, evaluating, and communicating information	Com

http://www.nextgenscience.org/resources/appendix-f-science-and-engineering-practices

Lesson Planning and Implementation

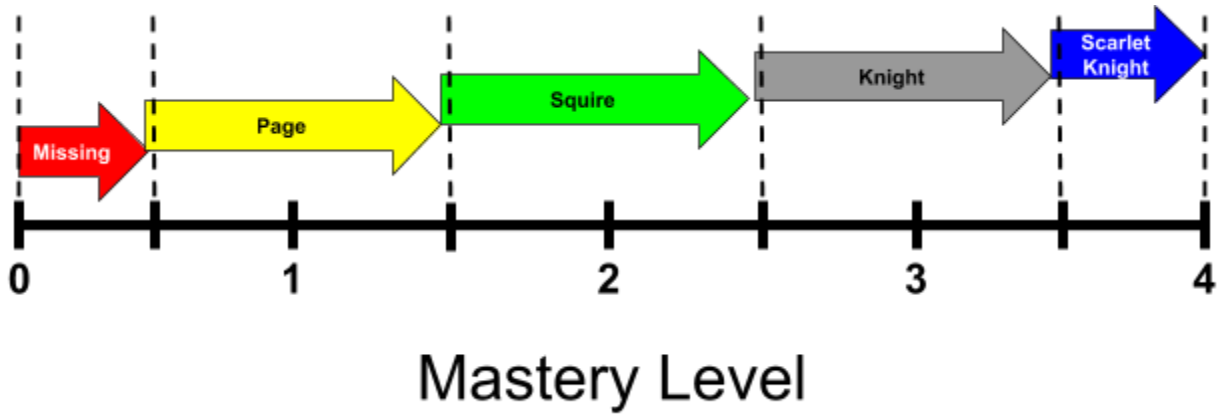
Teacher Standards

As teachers we must always plan for student engagement and learning and find techniques to accomplish our goals that fit with our personalities and teaching styles. Whether pre-service or practicing teachers we should all strive to improve our planning to be based in standards (of our own and mandated) and to better scaffold and differentiate our lessons based on our students' needs. And with a variety of formative assessment types we can give students feedback and give ourselves feedback for future planning.

My **formative assessments** give me feedback about students' progress in the lesson and are appropriate to the activity.	FoA
My activities are designed to **scaffold** student learning in developing scientific concepts through engineering or using scientific concepts to engineer designs and devices.	Scf
I can **differentiate** activities for students of varying skills levels and academic background.	Dif
I base my lesson planning on NGSS **standards** of Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts. My lesson plans work towards a larger goal of student achievement (Performance Expectation).	Stn

Grade Calculation

Each standard is assessed multiple times and all scores for each standard are averaged. Standards are then identified as being:



$$Final\ Grade = \frac{\#\ of\ Scarlet\ Knights\ acheived + 0.85 \times (\#\ of\ Knights\ acheived)}{total\ \#\ of\ standards}$$

Course Schedule by Week

Week	Topics to be covered	Assignments & Readings
7/25/16 - 7/28/16 **M, T, W, Th** **Room 211**	Next Generation Science Standards Standards-Based Assessment & Grading Differentiation ● Bridges ● Roller Coasters	To be announced.
8/1/16 - 8/4/16 **M, T, W, Th** **Room 211**	Engineering Design Process & ISLE Simulations vs. Equipment Interdisciplinary Projects ● Elevators ● Bungee Cords	To be announced.
8/8/16 - 8/11/16 **M, T, W, Th** **Room 211**	Lesson Planning & Assessment-Building Student-led & Need-based Engineering ● Telescopes & Microscopes ● Catapults ● Zombie Weapons	To be announced.
8/15/16 - 8/17/16 **M, T, W** **Room 211**	Final Exam Week	