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DNA Extraction Using Engineering Design: A STEM Integration Unit (Curriculum Exchange)

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Tamara J. Moore, Ph.D., is an Associate Professor in the School of Engineering Education and Director of STEM Integration in the INSPIRE Institute at Purdue University. Dr. Moore's research is centered on the integration of STEM concepts in K-12 and postsecondary classrooms in order to help students make connections among the STEM disciplines and achieve deep understanding. Her work focuses on defining STEM integration and investigating its power for student learning.

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Target Grade Level: 6-8

Engineering to Transform the Education of Analysis, Measurement, & Science

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Project Description

The *Engineering to Transform the Education of Analysis, Measurement, & Science* (EngrTEAMS) project is an engineering, design-based approach to teacher professional development that has 50 teachers per year designing curricular units for science topic areas related to the Next Generation Science Standards. The project includes summer professional development and curriculum writing workshops, paired with coaching, to allow teams of teachers to design engineering curricular units focused on science concepts, meaningful data analysis, and measurement. Each unit goes through an extensive design research cycle to ensure its quality and is published in an online format.

Unit Description

This three week unit is designed for students in upper-middle grades. The instructional material combines the learning of cellular biology, biochemistry, biotechnology, and engineering design through a series of STEM integrated activities that allow students to use various aspects of engineering to solve a problem. In this STEM integrated unit, students explore cells, DNA, biotechnology, and surface area to complete an engineering design challenge. The engineering challenge allows students take part in one aspect of health by improving a process used in the development of medicines.

Unit Summary

STEM Integration Activities				
	Lesson 1 (Day 1 & 2) Introduction: Engineering & Cells	**Lesson 2 (Day 3-5)** Biotechnology: DNA Extractions	**Lesson 3 (Day 6 & 7)** Surface Area: Data Analysis & Measurement	
	- Introduction to the design challenge - Review cell structure using a model - Identify and clarify the engineering problem	- Learn how to extract DNA from cells - Determine the amount of DNA extracted - Identify problem areas in the process - Begin brainstorming solutions	- Use physical and graphical models to explain the relationship of exterior and interior cells within tissues - Describe how this relationship influences the number of cells available to extract DNA from	
	Lesson 4 (Day 8 & 9) Biochemistry: Enzymes	**Lesson 5 (Day 10-12)** Plan, Test, Evaluate	**Lesson 6 (Day 13-14)** Redesign	**Lesson 7 (Day 15)** Client Recommendations
	- Qualitatively explore the various factors that affect enzymes - Consider how these factors might influence the design solution	- Design a process to improve the yield of DNA for a client within a set of constraints - Assess the effectiveness of the design	- Improve the efficiency of the DNA extraction process through redesign	- Present findings and make recommendations to a client

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