Testing Stream
Crossings
Lee Academy

Grade: 11/12	Content Area: Physics
Quarter/Trimester: 1 2 3 4	Unit Title: Testing Stream Crossings
Unit developed by: Susan Linscott	Date developed/Revised: 3/4/16

Stage 1 – Desired Results

G

Established Goals (standards):

HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

MP.2 Reason abstractly and quantitatively.

T

Transfer:

Students will be able to independently use their learning to design, create, test, and evaluate engineered structures for strength, the ability to withstand applied forces, the transfer of momentum, and their impact on the environment.

U

Understandings:

Students will understand that:

- forces impact the shape and strength of structures.
- the shape of a structure affects its ability to withstand the impact of forces.
- momentum is conserved as it is transferred from one object to another.
- there are many factors, including, but not limited to *the purpose of the structure*, cost, and environmental and community impact, that influence how an engineering project is implemented.

E

Essential Questions:

Students will keep considering….

- T = How is a stream crossing engineered and built to minimize the effects of applied forces and the transfer of momentum? (apply)
- T = How is a stream crossing tested and evaluated to determine how well it is withstanding the effects of applied forces and the transfer of momentum? (perspective)
- O = How is an engineered structure evaluated to determine the extent of its environmental and community impact? (perspective)
- O = How can we analyze and explain the level of success and impact of an engineering project and communicate our results? (explain, perspective)

K

Students will know…

- Newton's laws of motion
- that momentum is conserved in elastic and inelastic collisions
- that momentum is transferred by an applied force
- what erosion is
- examples of how engineering projects impact communities and the environment

S

Students will be able to…

- design, build, and test structural models for strength
- measure, calculate, evaluate, and explain how applied forces affect the structural integrity of models
- measure, calculate, evaluate, and explain how the transfer of momentum affects the structural integrity of models
- measure and evaluate the environmental impact of different structural models
- compare the structural integrity and environmental impact of different models
- explain how outside factors such as cost and community and environmental impact influence engineering projects

Grade: 11/12	**Content Area: Physics**
mester: 1 2 3 4	**Unit Title: Testing Stream Crossi**
Unit developed by: Susan Linscott	**Date developed/Revised: 3/4/16**

Stage 2 – Assessment Evidence

T

Performance Tasks:

Students will show that they really understand by:

- designing and building a model bridge, arch culvert, and culvert (apply)
- testing, measuring, and comparing their models by applying weight for a set time and observing deflection to evaluate the effects of transferred momentum (apply, perspective)
- testing and evaluating each model for its effects on streamflow and erosion by setting models up over a simulated stream, observing flow patterns, and measuring and comparing changes in the stream bed (apply, perspective)
- writing a lab report in which they analyze and explain their quantitative and qualitative observations and evaluate how the best solution to this engineering problem is affected by its environmental impact, cost, safety, and reliability as well as possible cultural impacts (explain, apply, perspective)

O
E

Other Evidence:

Students will show they have achieved Stage 1 goals by……

- completing background research and sharing findings with group and teacher
- completing data sheets and graphs to summarize results of tests and sharing with group and teacher
- completing a rough draft of lab report to receive teacher feedback before submitting final draft

Stage 3 – Learning Plan

Learning Plan:

W: Discuss the goals and essential questions of this unit. Discuss what students what performance task will look like and reasoning behind this project.

H: Visit culvert at bottom of soccer field and have students examine the extent to which culvert is performing its function (supporting loads, preventing flooding/washouts, allowing uninhibited streamflow, and impact on environment). Watch and discuss presentation created by local forester and culvert video.

E1: Experiment with virtual bridge-building animations and examine and compare how forces and momentum impact different structures.

E1: Students are provided with materials to examine and then generate blueprints/design plans for each stream crossing (bridge, culvert, arch culvert).

E1: Use provided materials to create model stream crossings.

E1: Apply forces to each structure and measure deflection of structures.

E1: Set each model in a model stream bed and measure impact of model on streamflow and erosion.

E1: Use appropriate measurements to calculate transfer of momentum and assess impact of applied force.

E1: Create spreadsheet and use it to compare results of each structure.

E1: Write draft lab report that includes analysis of results and evaluation of cost and environmental impacts of structures. Use feedback from teacher to write final lab report.

R: Students will provide each other with feedback as they design and test their structures. The teacher will provide feedback to the students on their data, calculations, and lab report before turning in a final draft.

E2: Students are asked to reflect on the following questions in the conclusion section of their lab reports:

- What did was successful about this project?
- What was not successful about this project?
- How can you improve this project?

T: The activities in this unit address different learning styles. Data is collected in groups and reports are completed individually. Students will work in groups to design, build, and test their models. Students will complete their lab reports individually. Accommodations for individual students will be made as necessary, particularly for measurements, calculations, and reporting.

O: The essential questions are addressed at the beginning of and throughout the unit. The activities are sequential, leading to final evaluation of the strengths and impacts of the model stream crossings. The following habits of mind from the Lee Academy common syllabus are addressed in this unit: Persisting, Thinking and Communicating with Clarity and Precision, Gathering Data Through All Your Senses, Striving For Accuracy, Questioning and Posing Problems, Thinking Interdependently, and Applying Past Knowledge To New Situations.