6E Learning by*D*e*S*IGN™ Model (Burke, 2014)

Ocean Engineering: Platform Design Challenge

This lesson presents a variety of STEM concepts that may be prefaced with other activities to help introduce concepts investigated in this engineering design challenge. Major crosscutting concepts taught in this lesson examine structural technology, the forces that act on structures (ex. tension, compression, and shear), natural forces (e.g., earthquakes, tsunamis) and environmental impacts of these forces.

Objectives:
Students will:

1. Demonstrate the application of energy transfer and sum of forces.
2. Apply science, engineering design process, and mathematics to the task of designing and constructing the technological system that provides evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object
3. Select the appropriate materials and tools needed and demonstrate their safe use to construct a working prototype of a system to address the design challenge.
4. Communicate project results that support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object

Higher Order Thinking Prompts

Engage Time: 1 class period	1. What is an earthquake? What is a tsunami? 2. What forces can you identify in the earthquake and tsunami video? 3. How are the forces similar? Different? 4. Can you identify an example of how forces build on one another? 5. Can you identify an example of buoyancy? Energy transfer? 6. What do you think would happen if tsunami occurred on the East Coast of the United States? 7. What impacts do earthquakes and tsunamis have on the environment? How about on humans? 8. Record the following terms in your STEM journal. Write down examples, definitions, questions, and/or comments concerning these terms: kinetic energy, potential energy, buoyancy, gravity, friction, sum of forces, energy transfer, and mass
Explore Time: 1 class period	1. What do you think would happen to the Sea Orbiter in a tsunami? 2. What forces do scientists need to consider when designing a platform that will be in the ocean as compared to land? 3. What energy transferences do scientists need to consider in designing the platform?

Explain Time: 1 class period	1. What safety precautions must you take when designing your solution? How will you work safer? 2. What is your goal for the activity? 3. What constraints must you meet? What types of constraints are engineers and scientists faced with? 4. What forces will act upon your design? 5. What energy transferences might occur? 6. What are do you already know about platforms that you can use in designing your platform? 7. Which steps or actions must you go through to develop a final solution?
engineer (Extend/Elaborate) Time: 3 class periods	1. How did you determine the materials to use? 2. What is the relationship between your materials choice and the strength of your design? 3. What affect does wave action have on the strength of your design? 4. What forces are acting upon your design? Did your answer change from the one given before you built and tested your design?
Enrich Time: 2 class periods	1. How were the various platform designs similar? Different? 2. What design proved to be the strongest, most stable? Why? 3. What types of materials prove to be the most useful? What characteristics of these materials made them better than others? 4. What types of materials could be used/substituted if you scaled up the design to a full-scale platform? 5. What forces and energy transference would have to be considered for a full-scale platform?
Evaluate Time: 1 class period	1. In which rubric criteria did you perform well and which areas could you improve? What could you have done to improve your performance? 2. Did your categories on the Card Sort change? If so, why? 3. How could the impact of energy transference and forces be reduced on the platform? 4. In what ways can scientists used energy transference and forces to build a platform that can withstand natural processes (e.g., earthquakes and tsunamis)?