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Phase I – Research and Planning – Due Date: Midterm Sept 25, 2019

Chose the "Lunar Base Supply Egg Drop" from the NASA "On the Moon Educator Guide" and modified it for Army Helmet applications. " Design a Helmet for an Egg Activity"

(this was actually developed for a STEM camp and is tried with 64 students – 4 groups of 16)

Notebook is being kept highlighting the development of challenge using the engineering design process.

1. **Identify the "Big" concept to be covered by the engineering design challenge.**

Each student will create/ design - sketch a prototype of a protective helmet for an egg, then the students will be divided into teams and each team will build a prototype using a variety of materials available. The goal of the helmet will be to protect the egg (brain) and prevent it from injury when it is dropped or hit. As a "soldier for the day" a helmet will be an essential piece of equipment "soldiers"/students will need to wear for protection while performing their mission.

The challenge is to design a helmet to protect them or any solider while on their "mission". They need to look at size, fit, and function and determine the best design and materials to use in protecting the head (skull and neck) and brain (traumatic brain injury) or in this case the egg, during an explosive type event such as an IED and/or during parachute jumping.

After testing we will evaluate designs which were successful in protecting the egg from damage and discuss why these designs worked.

This lesson connects to technology, science (physics) – materials, biomechanics –fit, function, safety, brain functions - engineering and math. This activity can also be tied into a lesson given by the airdrop directorate on parachutes.

2**. Research appropriate learning standards associated with the topic.**

Tenets of the Nature of Science (NGSS, Appendix H, 22013 and NGSS, NOS, 2013))

Scientific Investigations Use a Variety of Methods

Scientific Knowledge is based on Empirical Evidence

Scientific Knowledge is Open to Revision in Light of New Evidence

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Science is a Way of Knowing

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

Science is a Human Endeavor

Science Addresses Questions about the Natural and Material World

Science and Engineering Practices in the NGSS (NGSS, Appendix F, 2013)

Practice 1 Asking Questions and Defining Problems
Practice 2 Developing and Using Models
Practice 3 Planning and Carrying Out Investigations
Practice 4 Analyzing and Interpreting Data
Practice 5 Using Mathematics and Computational Thinking (qualitative and quantitative data)
Practice 6 Constructing Explanations and Designing Solutions (tradeoffs)
Practice 7 Engaging in Argument from Evidence
Practice 8 Obtaining, Evaluating and Communicating Information

‘’**All Standard, All Students” ; Making the NGGSS Accessible to All Students** (NGSS, Appendix D, 2013)

Common Core State Standards for Mathematics (CCSSM) (NGSS, Appendix L)

MP1 Make sense of problems and persevere in solving them

MP2 Reason abstractly and quantitatively.

MP3 Construct viable arguments and critique the reasoning of others. (Conceptualize and deconceptualize)

MP4 Model with Mathematics (weather)

MP5 Use appropriate tools strategically.

3. Identify and discuss the different types of problem solving and declarative/procedure knowledge needed.

The problem solving is being based on the NASA Engineering Design Process model. There needs to be both declarative/procedure knowledge depending on which step you are on. Declarative will focus on what needs to be done and the procedure will give boundaries and direction on reaching the solution to a problem.

4. Explore objectives and ancillary concepts/content covered by the project.

The objective is to create a helmet that protect the egg (the soldier’s head) Human factors - weight, and comfort – will be discussed in relation to designing any helmet under all extreme conditions. If it is not acceptable to the wearer, they will be not wear it no matter how much protection it provides.

5. Identify possible activities.

Videos of Lego egg drop designs to stimulate Students creativity while creating their design.

- #RBKLS. (2017, Aug 31). *LEGO Egg Drop Challenge – REBRICKULOUS*. https://www.youtube.com/watch?v=_i40cc_2GAU
- #RBKLS. (2018, Sep 21) LEGO *Egg Drop Challenge Part 2! – REBRICKULOUS.* https://www.youtube.com/watch?v=t1OKrj5Z-Ew

Will use sketch noting throughout the lesson and will lead them through the process by sketch noting on a white board or flip chart. This will allow students to visualize important criteria and document their thought processes before and while designing and creating their helmets.

This hands-on activity will allow students to be creative while working on real world issues they can relate to. By engaging students in experiential learning, as opposed to academic learning, they will be able to see firsthand the importance of wearing a helmet and the designs which provide the best protection. Two principles will be important in designing the helmet to be impact resistant 1- it must be able to absorb the impact of a fall by decreasing movement of the brain within the skull and 2- it must be able to distribute the impact over the surface area of the helmet to decrease the risk of a skull and/or neck injury and/or traumatic brain injury

Once the helmet prototypes are made, we will compare their effectiveness through testing. Each group will present their design explaining the rationale they used in designing the helmet. Then the helmet clad egg will be placed in a Ziploc bag to contain any breakage (should it occur) and dropped from a distance of about 3 ft. - table height to floor. Due to the fragile nature of eggs the feedback is immediate and the effects can be pretty dramatic if the egg shell is cracked or crushed and the yoke broken.

Prior to testing the students will be given the opportunity to name their egg and draw features on them to give them their own personality. This also allows students to be creative, have a little fun and bond with their eggs.

While these helmet designs will not be graded, a rubric will be developed for students to use as a guide when designing their helmets.

After testing student helmet designs, the class will discuss the strategies that worked and the ones that didn't work in protecting the egg from damage and discuss why these designs worked. Through discussions the philosophies for dissipating and absorbing energy over the helmet surface (in terms of material properties, helmet use and protection required, and design) will be discussed and the protection designed through the use of crushable materials versus crackable materials will be addressed.

6. Select the best activity for your classroom.

The best activity is to hands on creating of the helmet (packaging for the egg) They can work individually, yet will be with a team, Each student will be able to share with the other students how they are problem solving and implementing the engineering design process. I think all the above activities are essential if we want to teach the engineering design process.