Introduction

Did you ever wonder what we do at the U.S. Army Natick Research Development and Engineering Center (NSRDEC)? Can you imagine what it is like to be a soldier? Today we will take you behind the scenes as you become “A soldier For a Day”. We will be sending you on a mission - to patrol the mountains of Afghanistan. Pay close attention as you learn about the science behind the soldier because your life or the life of a fellow soldier may depend on it! In the next few hours you will need to decide which items you will need to reach your goal- for everyone to successfully complete the mission and safely return to base camp.

NSRDEC has four core competencies: soldier clothing and equipment, food, shelter and air drop. In this assignment I will concentrate on the soldier’s clothing and individual equipment. I choose “Suited for Spacewalking” (NASA, n.d.) as my data integration source because like astronauts, soldiers have captured the imagination of children for generations. The uniforms and equipment the soldier wears and carries spark the interest and curiosity of not just children but adults as well. People love to try on soldier’s uniforms and equipment and take pictures dressed up as a soldier. Much like astronauts, soldiers need to be prepared to function under very austere conditions and they too have specialized uniforms and equipment to provide protection.

Methods

The day will begin with a mission brief. In the brief we will provide the context for the decisions the students (as soldiers) will need to make. The mission brief will include: location, (where they are and where they will be going), the weather and climate, terrain, and the size of

the group performing the mission **(**squad, platoon, or brigade). This will be done using a series of PowerPoint slides showing a map with the location the students (soldiers) are deployed to and photos of the area so they can visualize the terrain. A weather chart will graph the temperature of the region as well as typical weather conditions, which will be needed in determining the clothing and equipment needed.

One of the major challenges with designing clothing and individual protection for the soldier is weight. We are constantly challenged with lightening the soldier's load. Therefore in presenting the soldiers' clothing and equipment items the impact of weight or load on performance (and thus the student's ability to complete the mission) will be highlighted. When possible, we will discuss similarities and differences of soldiers clothing and equipment in relation to items students may wear or be familiar with such as helmets – (helmets they wear bike, ski, baseball, football etc. vs. the helmet a soldier wears) discussing topics such as impact resistance (NASA, n.d. pg. 53). ballistic protection, traumatic brain injury etc. This will engage them by making a connection to their world. Then we will evaluate the ballistic vest. Students will be presented with two ballistic vests and we will compare the design and note the changes made. Then we will discuss the reasons for the change and the impact of the changes based on real soldiers' feedback and performance. Next we will evaluate the weight and construction of a soft armor system vs ceramic plates and discuss weight differences vs. protection levels. Students will have the chance to try on a vest and weigh themselves with and without a vest to compare weight differences and observe if the weight differences are perceivable between the two different designs and/or the weight differences between different configurations -soft armor only, soft armor combined with plates, soft armor with front plates but no side plates. We will

discuss why soldiers may choose one over the other in the context of protection versus mission performance. Likewise students can try on a rucksack and fill it with Meal Ready to Eat (MRE) pouches (food) and measure the weight using hand held scales, floor scales and/or just experience the feel of the weight as they sling it over their shoulder or hang it on their back. We will discuss how to pack a rucksack most efficiently and the impact on performance (maximizing load and energy) again drawing on a student's own experience in carrying backpacks. Throughout the process we will discuss the tradeoffs or decisions the soldiers/students need to make and the impact of those decisions on the outcome of the mission. Students will be afforded the opportunity to ask more in-depth questions, if desired.

Data obtained through the use of scales will allow them to put everything in perspective – (how much did it weigh – did they perceive the difference in weight between different systems etc.) The combination of actually experiencing the weight and then recording the data and translating it into a concrete value - weight gain (lbs.) is a very powerful learning tool and it reinforces the impact of weight on performance first hand. It is an eye opening experience!

Next we will discuss various protection built into the soldiers uniform - insect repellency, water resistance, wrinkle resistance, flame resistance, ballistic protection, chemical protection, environmental protection (NASA, n.d. pg. 9), signature management (camouflage patterns), and moisture management, along with the physical properties of the material - breaking strength (NASA, n.d. pg. 51), tearing strength, colorfastness, durability /abrasion (NASA, n.d. pg. 57), lightfastness etc. and the impact these characteristics have on the uniform's overall performance, the design of the item (NASA, n.d. Pg. 11-16) and the soldier's ability to

perform his mission or tasks. (NASA, n.d.) Here weight, and bulk as well as other considerations such as comfort will be discussed in relation to the performance of a soldier's mission. (Each one of these areas could be an individual lesson plan by themselves so the challenge is to present a general overview to provide students a meaningful glimpse at the science, engineering, math, and designing that goes into the soldiers' clothing in the limited time available without overwhelming them.)

Using an interdisciplinary approach, cross cutting concepts are being integrated as described in the Next Generation Science Standards (NGSS, 2013) and Common Core State Standards (CSSS, 2018). Below is an example of just two cross cutting concepts being incorporated through data integration.

MS-ETS1-3: "Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. " (Kastens, 2015).

HS-ETS1-3. "Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts." (Kastens, 2015).

While time is a constraint with school visits, labs focused on more specialized areas could be incorporated such as absorption and radiation (NASA, n.d. pg. 75), getting the right fit (NASA n.d. pg77), field of vision in helmet design and light transmission (NASA, n.d. pg. 90-91), and microclimate cooling (NASA, n.d. pg. 71). All important factors in designing a uniform or equipment for a soldier or a Spacesuit for Mars (NASA, pg. 43).

Justification

Currently, there is no structure to the tours that NSRDEC provides to middle school students. Implementing a "Soldier for a Day" activity will serve several functions: provide students with a better understanding of what NSRDEC does, provide insight into how STEM is used in developing products for the soldiers utilizing a backward design approach (ByBee, 2013), provide activities which integrate the science NSRDEC does into something the students can relate to and understand through engaging them in hands-on activities and provide project officers with guidelines to present their areas of expertise in a unified way which connects it all together for the student. Through first hand observations and experiences students will leave with a deeper understanding not only of the tradeoffs involved in engineering and designing clothing and equipment items (the STEM - science, math, technology and engineering – behind the soldier and NSRDEC) but hopefully a deeper appreciation for our soldiers.

References

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