Connecting to the *Next Generation Science Standards* (NGSS Lead States 2013)

*The following chart highlights the featured lessons in this paper.

Standard:
HS-PS2 Forces and Interactions
The chart below makes one set of connections between the instruction outlined in this article and the *NGSS*. Other valid connections are likely; however, space restrictions prevent us from listing all possibilities.

Dimensions	Classroom Connections
Science and Engineering Practices **Constructing Explanations and Designing Solutions** Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	Students discussed an article that detailed design solutions that didn't work for all people. To create their own designs, they considered the needs for a chosen population, designed and constructed an egg safety device for the targeted population, and collected data for analysis to determine what worked and what needed to be modified.
Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.	Students read and discussed Unesco data around the gender gap in science. They analyzed the data and discussed needs and solutions to the problems conveyed by the data.
Obtaining, Evaluating, and Communicating Information Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	Students identified a product that did not serve a particular population to the best possible ability. They conducted independent research in advance of considering design solutions which they offered in a formal letter addressed to the board and/or CEO of the company producing the product.
Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).	

Disciplinary Core Ideas **PS2.A: Forces and Motion** Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.	Students explored momentum as the product of mass and velocity by using changing mass and velocity in the bumper car simulation. Students incorporated their understanding of momentum as the product mass and velocity by considering the change in momentum of their egg safety devices, upon collision with the ground after a freefall drop. Students designed, tested, and systematically revised egg drop safety devices, intended to support the needs of a targeted population.
Crosscutting Concepts **Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Systems can be designed to cause a desired effect.	Using a bumper car simulation, students explored the cause and effect relationship between mass and velocity before and after a collision. Students collected data on the successes and needs of their egg drop safety devices to determine what modifications would be needed. They considered the effect of time of impact and the change in momentum to determine the force at impact.
Building Towards Performance Expectation (PE listing with Clarification Statement and Assessment Boundary) **HS-PS2-3. Apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.* [Clarification Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.] [*Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.*]**	

Connections to the *Common Core State Standards* (NGAC and CCSSO 2010)

ELA **RST.11-12.7** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, simulation) in order to address a question or solve a problem.

Mathematics
MP.2
Reason abstractly and quantitatively