Short Performance Assessment: **HS-PS2-3**

Grade Level: **High School**

Adapted from SNAP[1]

Title	**Engineering Challenge: Save Daredevil Daphne Duck**		
Designed by	**Brian Mellon - Saigon South International School**	Course(s)	**Physics**

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Performance Expectation	**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. **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.
Science and Engineering Practice	**Designing Solutions** • Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.
Disciplinary Core Ideas	**PS2.A: Forces and Motion** • If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. **ETS1.A: Defining and Delimiting an Engineering Problem** • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary) **ETS1.C: Optimizing the Design Solution** • 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. (secondary)
Crosscutting Concept	Cause and Effect • Systems can be designed to cause a desired effect.
Student Performance	1. Using scientific knowledge to generate the design solution 2. Describing criteria and constraints, including quantification when appropriate 3. Evaluating potential solutions 4. Refining and/or optimizing the design solution

[1] The Short Performance Assessment (SPA) and the Assessment Rubric adapted from the Stanford NGSS Assessment Project http://snapgse.stanford.edu/

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Engineering Challenge: Save Daredevil Daphne Duck

Task

Protect Daredevil Daphne Duck from certain death. Daredevil Daphne Duck will stun the world by launching herself from a catapult. Daredevil Daphne Duck is relying on you to design, create, and refine a capsule to reduce the impact force when Daredevil Daphne Duck strikes the ground.

Daredevil Daphne Duck must not die. Daredevil Daphne Duck is equipped with an accelerometer that wirelessly sends data regarding Daredevil Daphne Duck's acceleration. If the acceleration is too high on impact, Daredevil Daphne Duck will let out a horrifying shriek indicating the death of Daredevil Daphne Duck.

Requirements:

- Daredevil Daphne Duck must fit in the catapult basket while in the capsule you design.
- Daredevil Daphne Duck wants the mass of the capsule to be as small as possible to achieve the greatest possible launching speed. A prize will be awarded for the capsule that saves Daredevil Daphne Duck with the smallest mass.
- The use of the SSIS design cycle is to be documented. This cycle is shown here. A document is produced in which you explain how items on the outer ring were implemented.



- An understanding of how the impulse-momentum theorem saved Daredevil Daphne Duck must be demonstrated through the a calculation of the net impact force on Daredevil Daphne Duck while wearing your designed suit vs. the net impact force on Daredevil Daphne Duck from the control launch.
- A detailed conceptual explanation of how the impulse-momentum theorem saved Daredevil Daphne Duck is required.

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Name _____

SAVING DAREDEVIL DAPHNE DUCK GRAPHIC ORGANIZER

DESCRIBE THE PROBLEM.

CONSIDER POSSIBILITIES / BRIANSTORM IDEAS. Before researching spend 10 minutes thinking about possible solutions to the problem. Write down ideas and make drawings that illustrate your thoughts.

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RESEARCH. Go online and look for ideas to help you design a capsule. Give descriptions of what you find that will be helpful (in words). How are the ideas you find similar and different to the ideas that you had when brainstorming? (20 minutes)

SKETCH DIFFERENT POSSIBILE DESIGNS. Use your ideas from brainstorming and research to sketch three possibilities for your design.

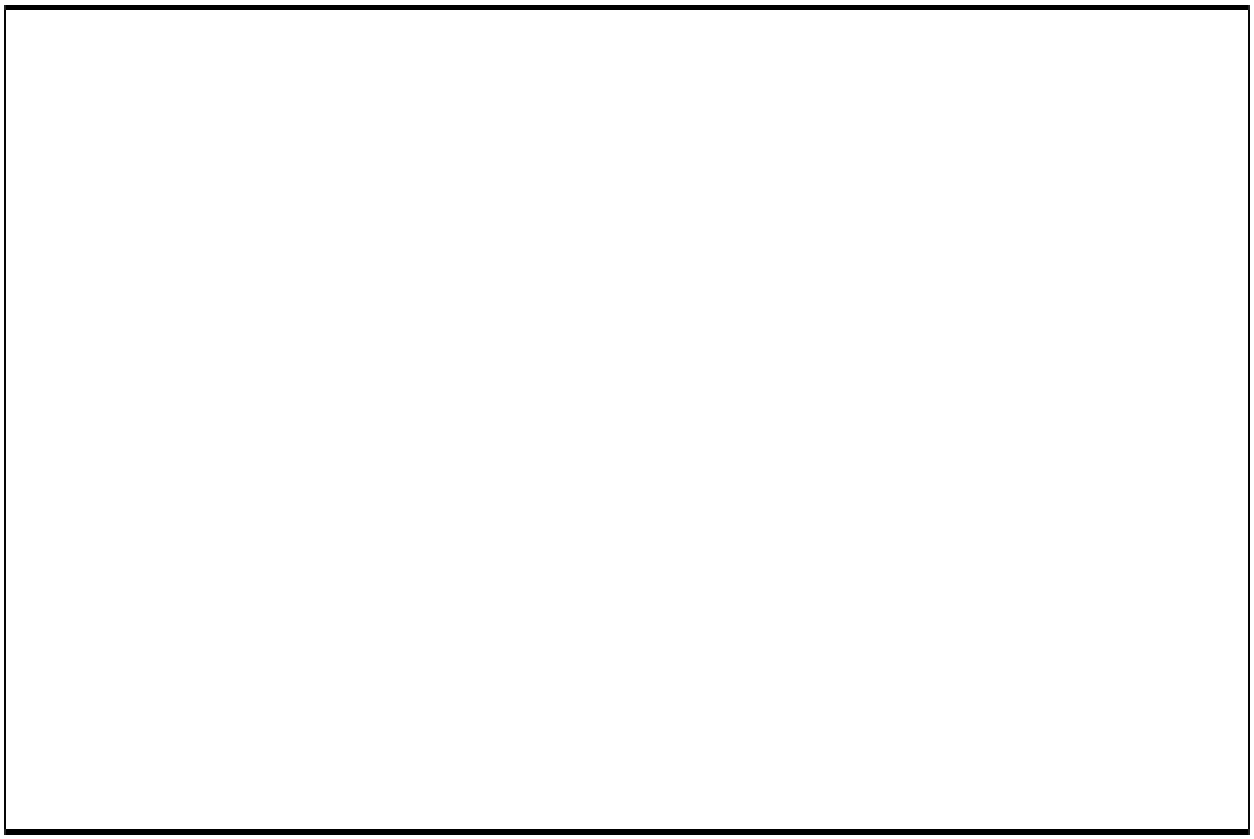
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COMPLETE A P.U.G.H. CHART. Rate each design on a scale of 1-5 (5 being most favorable) for each of the criteria below.

Model	Cost	Low Mass	Reduction of Impact Force	(add one criteria you believe to be important)

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DECISION. Which model will you build? Explain why. Make new drawing that shows the dimensions of your capsule.



MATERIALS. List the materials you need.

MAKE A PROTOTYPE AND TEST THE PROTOTYPE. USE DAREDEVIL DAPHNE DUCK TO COLLECT DATA TO SEE HOW WELL YOUR CAPSULE WORKS.

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WHAT CAN BE IMPROVED? How can you alter your capsule to decrease the impact force on Daredevil Daphne Duck? How can you alter your device to reduce the mass of the capsule?

REFINE YOUR DEVICE ACCORDING TO THE ABOVE ANALYSIS AND TEST AGAIN.

DATA FROM THE FINAL TEST. Show all data from multiple trials that will be used to determine the impact force on Daredevil Daphne Duck.

CALCULATIONS. Calculate the average impact force on Daredevil Daphne Duck.

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EVALUATE THE IMPACT OF YOUR CHANGES. Did your the revision of the device have the desired effect? Should you make further revisions. Explain.

EXPLANATION. How did the your design utilize the impulse-momentum theorem in order to save Daredevil Duck?

Claim	Evidence	Reasoning

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Assessment Rubric* - Question 1				
	Emerging	Developing	Approaching Proficiency	Excelling
Description of performance				
Sample student responses				

Assessment Rubric* - Question 2				
	Emerging	Developing	Approaching Proficiency	Excelling
Description of performance				
Sample student responses				

Insert additional Assessment Rubrics (if needed) here.

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