Grade 8 Design Challenge Quick Guide: Designing a Zip-Line – Cycle 2

Lesson Objective(s): Students will construct a zip-line transportation system and analyze the important factors in measuring the motion (time and distance) of an object.

Materials:

For teams of 2-3 students

- Design logs
- Handouts
  - "ForceStations" handout
  - "ForcesExitTicket" handout
  - "Math in Science" handout©- Part 2: Newton's Second Law only (pg. 2-3)
  - 21st Century Skills rubric for grading
- Scissors
- Tape
- Fishing line
- Balloon
- Straw
- Masses
- Design logs

Websites

- PHET online simulation of forces: http://phet.colorado.edu/en/simulation/forces-and-motion-basics
- PHET online simulation of forces (Spanish): http://phet.colorado.edu/es_PE/simulation/legacy/forces-and-motion
- Free Body Diagrams link: http://www.physicsclassroom.com/class/newtlaws/u2l2c.cfm
- Distance vs. Time graphs: http://www.sfponline.org/Uploads/71/distance-vs-time-graph-worksheet.pdf
- Concept transit cars: http://thecreatorsproject.vice.com/blog/8-mass-transportation-ideas-that-make-the-hyperloop-look-boring

For stations

- 2 spring scales
- 2 rubber bands
- 1 weight
- 1 electronic scale
- 1 wooden block

TEKS:

Science

*Ⓡ SCI.8.6C Investigate and describe applications of Newton's law of inertia, law of force and acceleration and law of action-reaction, such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches**.**

Ⓟⓢ SCI.8.2C Collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers.

Math

Ⓟⓢ 8.1B Use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution.

8.5H Identify examples of proportional and non-proportional functions that arise from mathematical and real world problems.

ELPS	CCRS Science	CCRS Math	CCRS Cross-disciplinary
C1C, C2I, C3J	2A7C, 8C2A	8C1C, 10A2A	1B3B, 1C3B

Engineering Design Loop: *For more details, refer to the overview page.*

Identify the Need: Teams of students will be challenged to create a zip-line transportation system.

Research the Problem Teams will conduct research on forces to understand the needed background information.

Develop Possible Solutions: Teams will plan for and design a first model to launch preliminary tests.

Select the Most Promising Solution: Teams will make several rounds of changes, decide which design is the best, and then create a sketch of their final design.

Construct a Prototype: Teams will build their final design and explain in their logs the step-by- step process they used to construct their final prototype.

Test & Evaluate: Teams will test and evaluate their prototype design by collecting quantitative and qualitative data.

Communicate their Design: Teams will communicate their design by completing the "ForcesExitTicket" handout to summarize what they have learned about free body diagrams.

Redesign: Teams will draw a sketch and write a paragraph description about their new concept transportation car and its features.

Math Connection: Teams will calculate forces and accelerations based on the formula, F=m x a.