RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of
	explanations or descriptions. (MS-PS2-1)
<u>RST.6-8.3</u>	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS2-1)
<u>WHST.6-</u> <u>8.7</u>	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS2-1)
Mathematics -	
<u>MP.2</u>	Reason abstractly and quantitatively. (MS-PS2-1)
<u>6.NS.C.5</u>	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS2-1)
<u>6.EE.A.2</u>	Write, read, and evaluate expressions in which letters stand for numbers. (MS-PS2-1)
<u>7.EE.B.3</u>	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-PS2-1)
<u>7.EE.B.4</u>	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-PS2-1)

Lesson 1: Zipline Activity(basic intro to motion)

<u>Objective:</u> Students will construct a zip-line to recognize and analyze the motion (and cause of motion) of an object. Students will begin to be able to evaluate the causes of motion and deduce the important factors in measuring motion (time and distance)

<u>Learning Goal:</u> Motion is achieved when a unbalanced forces are applied. The amount of mass and force affect motion of an object. Distances and time are necessary to calculate speed.



Vocabulary: motion, force, gravity, acceleration, balanced forces, unbalanced forces, speed, distance, time, reference point

Engage:

- 1. Teacher leads a class discussion and asks students "How many of you have ever been travelling somewhere and have been stuck in traffic for a long time? What do you think are some of the causes of the traffic?"
- 2. Students write down their responses and share with groups.
 - Possible student answers: too many people traveling, inefficient road ways, car accidents, broken down cars,
- 3. Teacher records their ideas on the board.
- 4. Teacher leads a conversation as to how public transportation can help to alleviate some of these major issues.

Explore:

Students are given the prompt that they all are working for a large transportation engineering firm that has been contracted by the city of Los Angeles to create a public transit system to travel directly from our location and to the beach.

- 1. After receiving the prompt students are given the expectations of the assignment:
 - Working in teams students will design a vehicle that is able to travel across the length of the room (or from chair to chair) using only the materials given: scissors, tape, fishing line, balloon straw, and masses.
 - The objective is for the vehicle to reach the other end of the room (or chair to chair) in the fastest time possible using only the materials given to them.
 - Students may being to investigate the impact adding mass will have on their speeds.
- 2. Students work in teams to design their vehicle and test the various strategies they have created.
- 3. Once students have made adequate progress, bring the whole class together to discuss the norms of building their vehicle. "How do you know that the object moved? What are some of the ways your teams are using the balloon? Did we notice any issues with how to place the balloon on the straw? Etc"
 - Having students share out the norms of building the vehicle will give an opportunity for students to learn from one another's design process, providing insight to what works and does not work.
- 4. Students make the final revisions on their balloon vehicles and record time and distance data for three trials.



<u>Explain:</u>

- 1. Teacher leads class discussion as to the cause of motion "What caused the vehicle to move? How can you describe the movement of your vehicle? What caused your vehicle to move faster or slower?"
- 2. Teacher explains that all movement requires an energy, or force, to start and end movement.
 - a. Teacher note: This lesson may be adjusted to various levels in the unit, it may be used to introduce motion, graphing, measuring motion, or unbalanced forces.
- 3. Introduce students to the idea of balanced and unbalanced forces.
- 4. "As scientists and engineers we need to be able to quantify and communicate how much force is being applied to objects, how do you think we can communicate how much force is being applied."
- 5. Introduce students to free body diagrams/ force diagrams.

<u>Elaborate:</u>

- 1. Students draw a free body diagram for their zip-line, both at rest and moving.
- 2. Students also will graph their data from the three trials. (Optional depending on pacing of class and order of progression)

<u>Evaluate:</u>

- 1. Students free body diagrams and speed calculations serve as their evaluations.
- 2. Students will also have a follow up worksheet to diagram several objects in motion and at rest.

Additional Resources:

PhET online simulation of unbalanced and balanced forces <u>http://phet.colorado.edu/en/simulation/forces-and-motion-basics</u> PhET online simulation of forces and motion in 1 dimension <u>http://phet.colorado.edu/en/simulation/forces-1d</u>

Lesson 2: Car Design (Add forces and the cause of motion)

<u>Objective:</u> Students will design and construct a self-propelled car to examine how forces are used to move objects.

<u>Learning Goal:</u> Students will investigate alternative ways to propel cars. What is the source of motion and the basic engineering cycle.

Vocabulary: Friction, Chassis, Force

