	use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS2-1)
6.EE.A.2	Write, read, and evaluate expressions in which letters stand for numbers. *(MS-PS2-1)*
7.EE.B.3	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)*
7.EE.B.4	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)*

MS Physical Science –Forces – Collision Safety

	What Causes Motion?	How is force measured?	Force Diagrams	Newton's 3rd Law
Student Experience	Students will observe different objects with different masses and predict which object will travel the furthest after an equal force is applied to each object. Based on their observations they will derive a pattern or 'law' that is supported by their observations.	Students create their own force meters using an elastic material (from the T4T cart) and calibrate them by hanging known masses and utilizing Newton's 2nd law to quantify force.	Using the information they have learned and the force meters they have created students will create free body diagrams for a single object to show how much force is required to overcome the friction force.	Students will observe Newton's 3rd law using their force meters to see that as you apply a force in one direction there is an equal and opposite force being applied which they will create a free body diagram.
T4T Material	Round objects with different mass, force apparatus, "plastic brains", corrugated plastic	Elastic material from cart, vinyl window blind, set of weights	Force meter, mass, small wood blocks, friction fabric tiles	Force meters
Big Idea	Newton's 1st Law. An object in motion will continue in motion with constant velocity unless acted upon by a net external force.	Newton's 2nd Law. $\mathbf{F}_{net} = m\mathbf{a}$. Weight: $\mathbf{F}_g = m\mathbf{g}$	Balanced v Unbalanced forces Free body diagrams	Newton's 3rd law
Connection to Culminating Activity	In order for any object to change its motion (to accelerate or decelerate) a force must be applied, such as gravity pulling the egg car down a ramp.	Students will need to know that force can be quantified in Newtons and that gravity is one of the major forces acting on the egg car	Students will need to know how to create free body diagrams in order to communicate the amount of force being applied to the egg and wall	During a collision the force applied to the egg car will be equal and opposite.
CA Standards	CA8.2.e CA8.2.f	CA.8.2.d CA8.2.g	CA.8.2.a CA.8.2.c CA.8.2.d	CA.8.2.a CA.8.2.b CA8.2.d

	Collisions with stationary objects	Research and Development	Egg Jousting
Student Experience	Students will be introduced to the egg car, ramp, and shown the collision of the egg at several different heights, establishing the force needed to break the egg. Students will begin to research how the force transferred to the egg can be distributed/ reduced.	Students continue to research different types of safety systems that may prevent injury, build their egg cars and test.	Students compete against one another to see who had created the safest egg car
Material	Egg car chassis, ramp, heavy stationary object, eggs, dummy eggs ,plastic bags	Egg car chassis, ramp, heavy stationary object, eggs, dummy eggs, plastic bags, various t4t materials for students to build	Egg car chassis, ramp, heavy stationary object, eggs, dummy eggs, plastic bags
Big Idea	Students establish that the lower the egg launch height the less force is transferred to the egg, the higher the launch height the more force is generated which is then imparted to the egg during the collision	Students begin research and build their egg cars so that they can mitigate the amount of damage done to the egg car, students must demonstrate their logic in their build design.	Students will have an opportunity to see what type of safety systems were the best by competing against one another.
Connection to Culminating Activity	The egg ramp will be used to demonstrate how much force is being applied to the egg and will allow students to see how much force they are trying to protect the egg from	Culminating Activity	Culminating Activity
CA Standards	CA.8.2.a CA.8.2.b CA8.2.d	CA.8.2.a-f	CA.8.2.a-f