# Lesson 8:Car Collisions

<u>Objective:</u> Students will be able plan an investigation to predict how several forces will impact the motion of an object and design a solution to increase the safety of their vehicle.

<u>Learning Goal</u>: The motion of objects is determined by the sum of forces acting on the object. Mass and Force affect motion of two interacting objects. When two objects interact each one exerts a force on the other.

Vocabulary: Net force, vector

## <u>Engage:</u>

- 1. Show students a video clip of the IIHS crash safety tests.
  - <u>http://www.youtube.com/watch?v=xtxd27jlZ\_g&feature=c4-overview-vl&list=PL983889014322C331</u>
- 2. Teacher leads a class discussion ask students "what are the engineers testing in these crash tests? How do you think we can predict the direction of the collisions? How does mass impact car collisions?"
- 3. Students brainstorm ideas and share in groups

#### Explore:

- 1. Students are shown the PhET simulation for collisions and are asked to change the masses colliding.
- 2. Students record any patterns that they notice as they increase the mass or the forces that are applied to each object.
- 3. Students share out the patterns that they notice in small groups.
- 4. Students are asked to diagram several car collisions with two and three objects colliding.
  - Students diagrams should be in the form of a free body diagram looking from the "top view" of the masses so that forces are only being considered in one plane.
- 5. Once students have designed there collisions they are asked to predict the direction of the masses after the collision has occurred.
- 6. To illustrate their predictions students will use free body diagrams to show the forces that are acting on the masses.

#### <u>Explain:</u>

- 1. Teacher explains how vectors/ forces can be added using vector addition using the nose to tail method.
  - This method is used to show how forces can be added together and illustrates the magnitude.



- 2. Using students' experiences from the simulation, students are asked to plan how they could plan an investigation to test how their car will perform during three collisions of increasing masses, 50g, 100g, and 150g.
  - Students are shown a stock car which mass can be added as well as a ramp to launch the stock car at a consistent speed. This will keep the speed constant, and therefore the force constant ( will only vary as the mass varies).

## <u>Elaborate:</u>

- 1. Students plan an investigation to show how cars will perform when collided with various mass cars.
  - Students investigation should include some way of measuring the cars performance, example: how far car travels after collision, or speed of car after collision
- 2. Once students design their investigation they will predict how their cars will perform and will give a safety rating.
  - Good, Acceptable, Marginal ,and Poor

# <u>Evaluate:</u>

- 1. Students will be evaluated as to how they plan their investigation, rate their cars, and support their ratings.
- 2. Students are also evaluated by how well they can predict several collisions using free body diagrams in the follow up assignment.

# Additional Resources:

PhET online simulation of collisions with masses

http://phet.colorado.edu/en/simulation/collision-lab

