Impulse and Collisions

Equipment

- LoggerPro, Motion Detector and Force Probe
- Carts and Tracks
- Happy and Unhappy balls

Objective

Data collection

- Set up appropriate experiment to measure force and motion as a function of time

Data analysis

- Determine the area under the force vs. time curve compare to change in momentum

Physics Concepts

- Impulse
- Conservation of Momentum

Conceptual (C-Level)

Newton recognized it took force to change an object's momentum. Suppose you wish to produce the greatest force on an object. You can throw either a bouncy ball or a non-bouncy (clay) ball. Each ball has the same mass and would interact with the object for the same amount of time. Using the ideas of impulse and momentum describe the collisions.

- Mathematically prove which ball produces the greatest force on the object.

Newton's Cradle is a toy you might have seen. It is a wooden rectangular box frame with multiple steel balls suspended next to each other in the middle such that they are free to swing horizontally. {Ask your instructor to show you this toy if you have never seen one.} Suppose you have 5 steel balls suspended in the middle. If you pick 3 balls up and release them, what will happen? Why??

Basic Lab (B-level)

Record the force and motion of the cart when it collides with an elastic object (happy ball) and an inelastic object (unhappy ball).

- Calculate the impulse from the force vs time graph
- Calculate the change in momentum
- Compare for different inclines and/or speeds

NOTE: Let a cart traveling on slightly inclined track hit a ball placed in front of a force probe mounted on the track. Remove the hook on the force probe so there is a flat interaction area. The tracks have a groove in the center that should help to keep the ball aligned. Increase the data collection rate (200 pts/sec is better than 20 pts/sec) and make sure you are not exceeding the force probe range (gentle collision). There are brackets available if you want to try different arrangements.

Advanced/Extended Lab Ideas (A-level)

Determine the momentum and energy before and after elastic and inelastic collisions. The carts have Velcro that can be used to stick them together. You can use two motion detectors but make sure they don't "see" each other and have cross talk confuse the position vs time data.

- Two cars of equal mass collide.
- A massive car colliding with a smaller car.
- A smaller car colliding with a massive car

What might you be curious to investigate?