COLLISIONS

Activity 1: One-dimensional collisions

According to the law of conservation of momentum, the total momentum of an isolated system remains constant.

Cars on the air track will collide, and we will determine their velocities before and after a collision from the time required for their flags to pass through photogates.

1. In Data Studio, open the activity Momentum.ds. Double click on the photogate icon and make sure the length of your cards is entered as the object length. **Do this for each photogates.**

2. Measure the masses of both cars. We'll treat them as exact since their relative uncertainties are quite small.

3. You will set up a collision where the cars begin "outside" the photogates. The collision will occur "between" the photogates. The cars must then return to "outside" the photogates. That way the photogates can measure the time for each car before and after the collision.

Draw before and after pictures of this collision, emphasizing the direction of the velocity of each car in each picture.

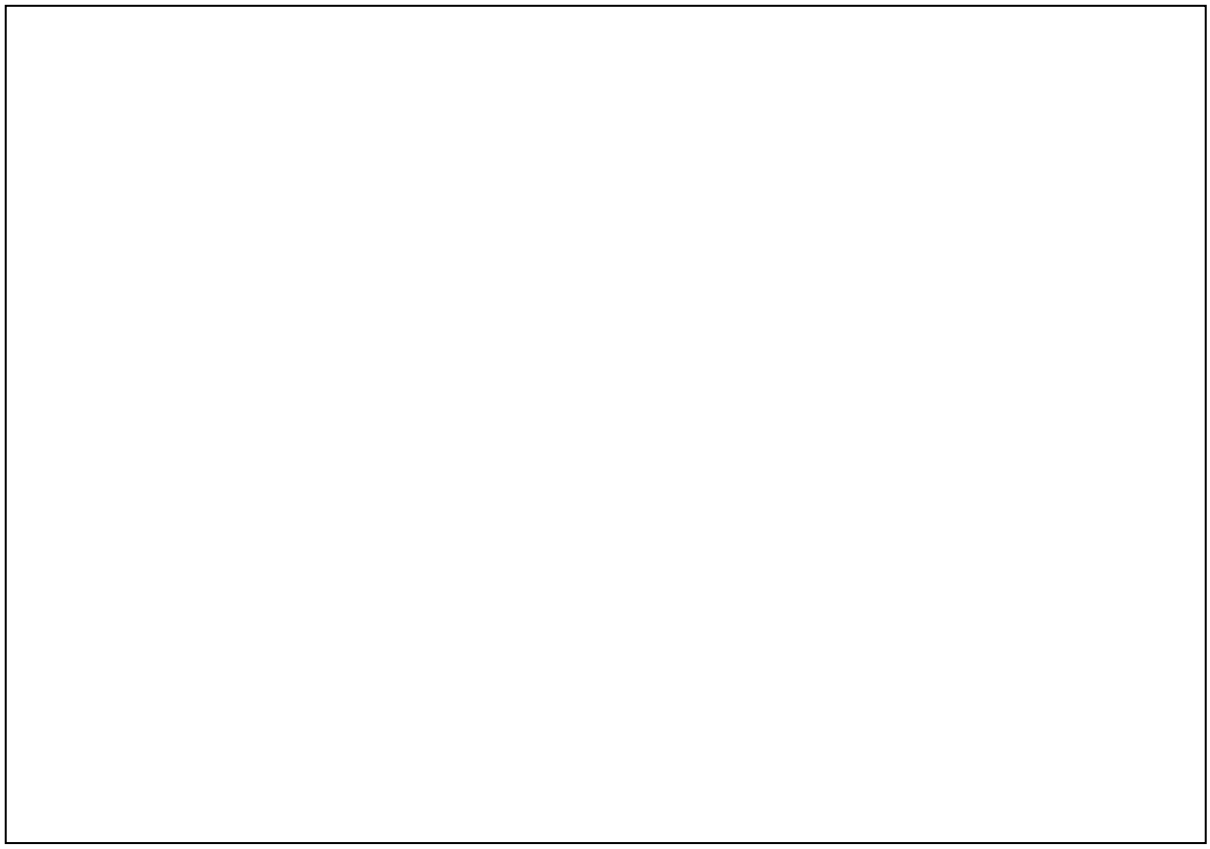
It may take a few attempts to get a useable set of data. Press REC to begin data collection and STOP after the cars have returned to "outside" the photogates. Go for it.

4. For the data set you use, enter the times for each car to traverse its photogate in and out.

5. Choose a coordinate system and calculate the velocity of each car, with appropriate sign, before and after the collision.

6. Is momentum conserved within uncertainty? If not, speculate on how the experiment differs from the idealized situation you analyzed theoretically? What experiment could you do to test your speculation?

7. Is the collision elastic? If the collision is elastic, the kinetic energy is also conserved. The kinetic energy is not conserved in an inelastic collision.



Activity 2: Two-dimensional collisions

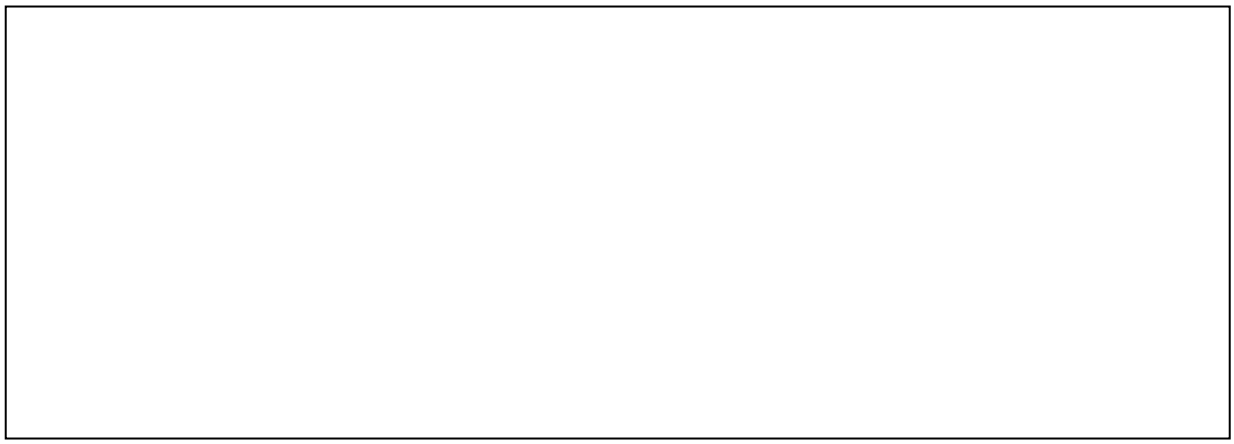
1. Open the video Activity2_TwoDimColl.mov in LoggerPro, (For tips on using loggerPro, see lab website).

2. Collect data from the motion of one of the balls in the video. Don't forget to set the scale. Don't take any data beyond 0.6 seconds into the movie. (Visible in upper right corner of the movie window.)

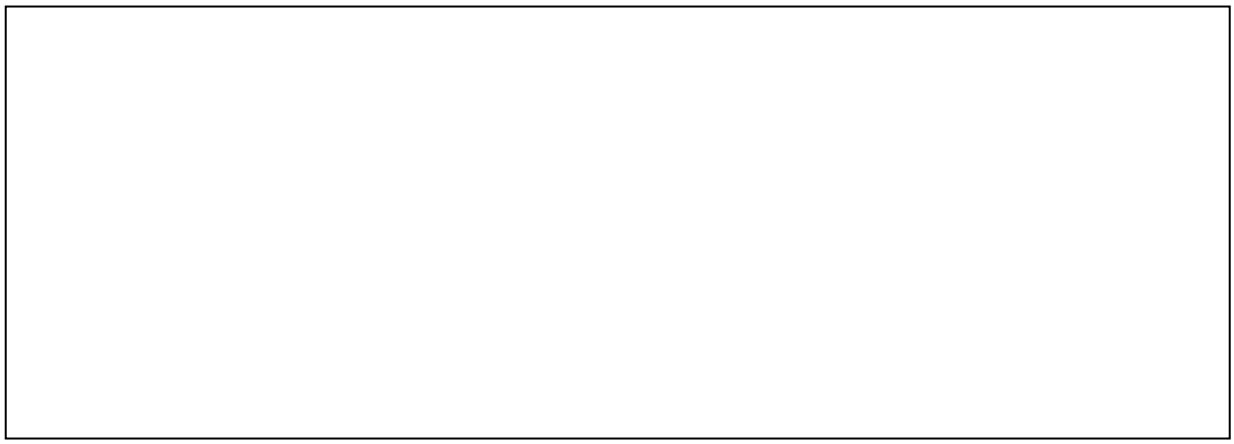
3. To collect data from the motion of the other ball, click the button with a red dot and a green dot and select Add Point Series. Now you can return to the first frame of the movie and click through all the positions of the second ball. Don't take any data beyond 0.6 seconds into the movie.

4. LoggerPro will automatically make a graph of the x- and y-components of the position of both the first and the second ball. We want to just see one component at a time. So to change what's plotted in the graph, left click the axis labels on the vertical axis and select more from the menu. Uncheck the boxes for the y-components, leaving only the x-components.

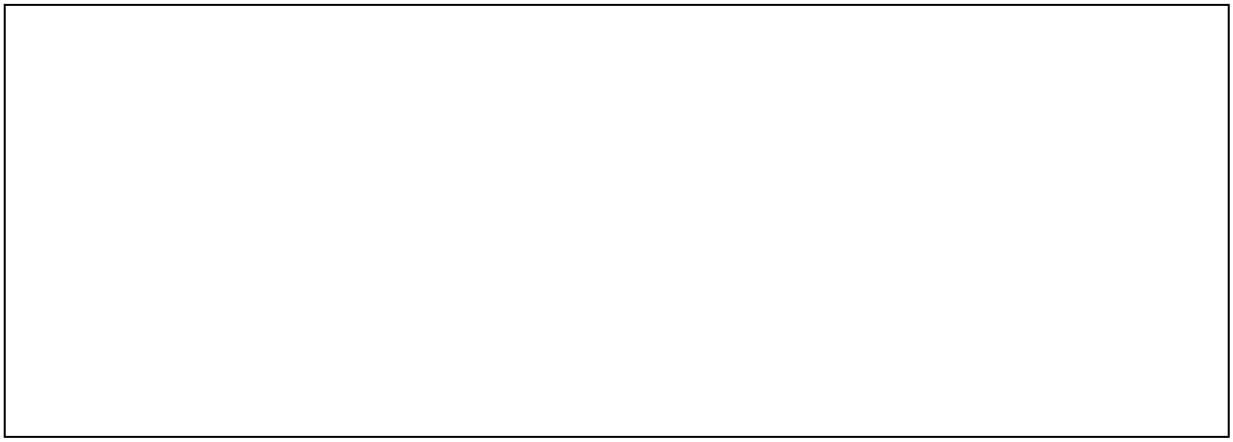
5. Use LoggerPro's curve fitting capabilities to get the x-component of velocity for each ball before and after the collision. (How can you get velocity from the position curve…? The video analysis tip sheet on the lab web page may be helpful.)



6. What is the x-component of the total momentum before and after the collision? Is it plausible that this component was conserved?



7. Now change the graph to show the y-components of position for both the first ball and the second ball. Use LoggerPro's curve fitting capabilities to get the y-component of velocity for each ball before and after the collision.



8. What is the y-component of the total momentum before and after the collision? Is it plausible that this component was conserved?