6C Collisions

Why do things bounce back when they collide?

Newton's third law tells us that when two objects collide, they exert equal and opposite forces on each other. However, the effect of the force is not always the same. What happens when you collide two Energy Cars that have unequal masses?

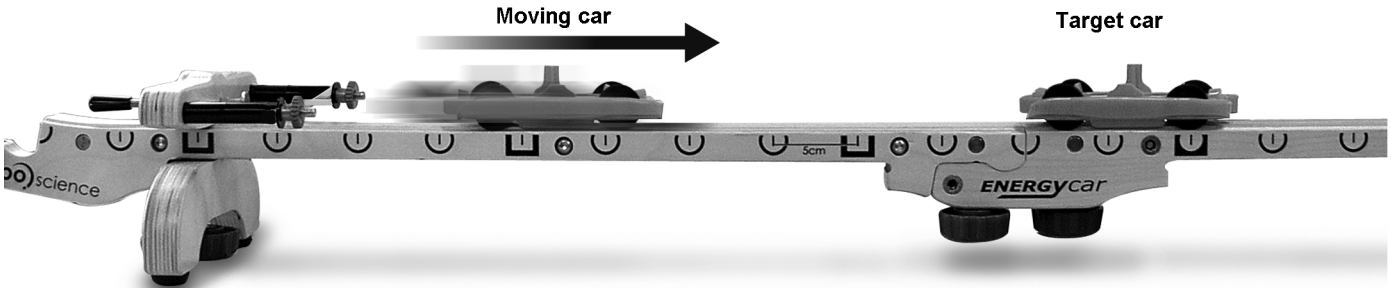
Materials

- Energy Car
- Data Collector and photogates
- Thick rubber band
- Electronic scale (or triple-beam balance)

1 Making a collision

Launching the Car

Rest your palm on the wood and pull the car against the screw with your finger on the tab nearest the far end of the car.



1. Set up the long straight track with a rubber band on one end and a clay ball on the other end. Use the bubble level to set the track level.
2. Place one steel marble in each car.
3. Wrap the thick rubber band around the moving car. Place both cars on the track so their noses are pointed toward the rubber band launcher.
4. Place the target car near the center of the track. Use the screw to launch the car using the same deflection of the rubber band each time. This means the same force is applied to each launch. You will use this car to create the collision.
5. To make a collision, release the moving car from the rubber band launcher. It will speed down the track, and hit the target car. This is an efficient way to produce collisions on the track.

a. Does the **moving** car bounce back after the collision?

b. Does the **moving** car keep going forward after the collision?

c. Does the **moving** car stop at the collision?

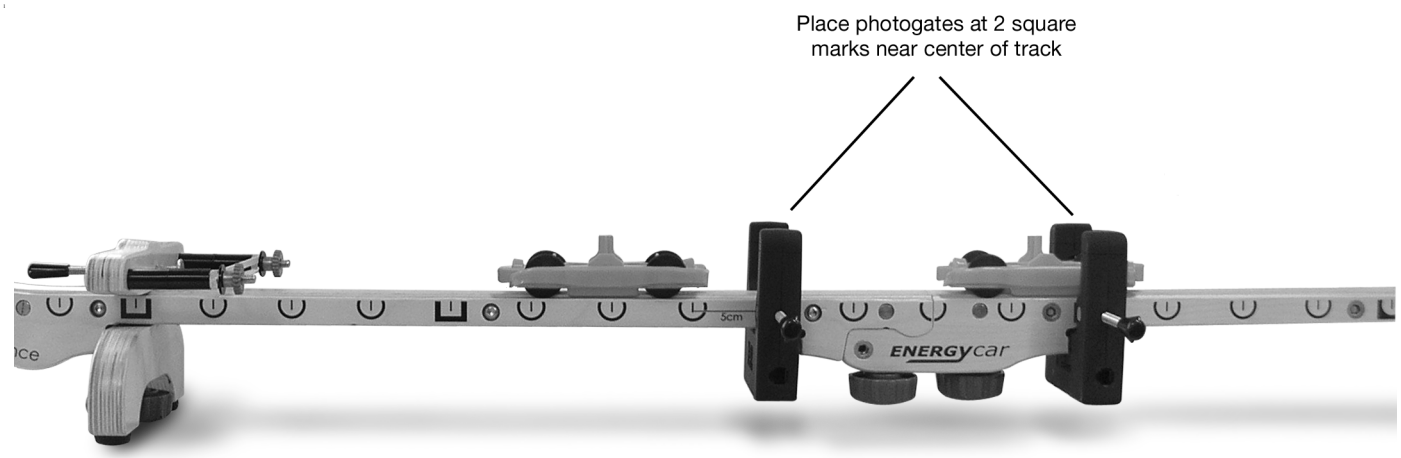
d. How does the target car behave?

2 Thinking about what you observed

a. Describe in words the motion of the two cars before and after the collision.

b. The target car must exert a force on the moving car to stop it. How strong is this force relative to the force the moving car exerts on the target car to get it moving? How could you use the photogates to provide evidence for your answer?

3 Gathering evidence



1. Try the experiment again, but now use two photogates to collect time data.
2. Place two photogates on the square marks near the middle of the track.
3. Put the target car on the track so it is near photogate beam B.
4. Release the moving car from the rubber band launcher as before and make a collision.
5. Repeat several times and record trial Times in Table 1.

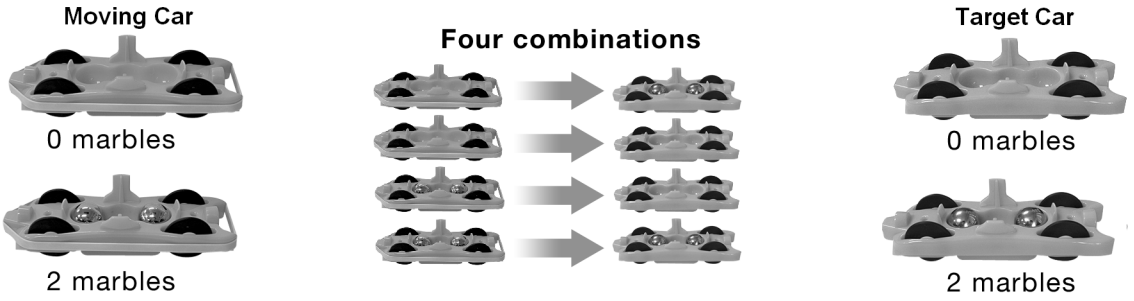
Table 1: Collision Times

Collision Trial	Time for moving car to pass through A before collision (s)	Time for target car to pass through B after collision (s)
1		
2		
3		
4		
5		

a. Newton's third law tells us that when the moving car exerts a force on the target car, the target car exerts an equal and opposite force on the moving car. Does your data provide evidence for this? Explain.

b. You can compare times through A and B for each individual trial. How can using these times show there are equal and opposite forces at work?

4 Changing the masses



Try the experiment with the four combinations of mass shown above. You do not need to use photogates for this part of the investigation.

5 Applying what you have learned

a. Describe the motion of the two cars when the target car has more mass than the moving car.

b. Describe the motion of the two cars when the target car has less mass than the moving car.

c. Explain how your observations support the idea that there are action and reaction forces.

d. If the action and reaction forces are equal in strength, why does one car move at a different speed after the collision than the other car when the masses are unequal? Hint: the answer involves the second law.