

Lesson 3: Newton's Third Law

Section 1: Exploration

Ex1: Two Car Crashes

Directions: Use the two videos to answer the questions below.

1. When one car crashes into the wall does the wall exert a force on the car? How can you tell?
2. When the two cars crash into each other do they each feel a force? How can you tell? What is the source of these forces?
3. Car crash tests are typically done at 35mph, which is approximately 15.6m/s. If the two cars each have a mass of 1600kg, about how much force does each car feel if the duration of the crash is 0.25s?

Ex2: Ice Skater Propulsion

Directions: Use the two video clips to answer the questions below.

1. Does the ice skater exert a force on the bowling ball? How can you tell?
2. Does the ice skater feel a force as a result of her actions? How can you tell?
3. Which object feels a greater acceleration? How can you tell?
4. A skater is roughly 7 times more massive than a bowling ball. If the skater's final speed is about 1m/s, what would you expect the bowling ball's final speed to be? Explain your reasoning.

Section 2: Discussion

This page is provided for note taking.

Section 3: Application

App1: Billiards

Directions: Use the video clip to answer the questions below.

1. Before you watch the video, look at the first frame. You can see two pool balls of identical mass. If the force of the cue stick propels the cue ball to a speed of $\sim 1.5\text{m/s}$ what would you predict its speed to be after it hits the object ball?
2. What would you predict the object ball's speed to be after the impact?
3. Pool balls typically have a mass of 0.17kg . Typically the balls stay in contact for 0.002s when they collide. What is the magnitude of the force each ball feels?
4. How would the video be different if the object ball were half as massive?

App2: Propeller Car

Directions: Use the video clips to answer the question below.

1. Explain the behavior you observe in the video clips using Newton's Laws.

App 3: Hitting the Wall

Directions: Think about the video of a car crashing into the wall. Answer the questions below.

1. In the Exploration we clearly observed that when two cars collide they each feel a force due to the other. Newton's third law says that when an object exerts a force on another object it feels an equal and opposite force exerted by the first object. In the two-object collision this is very clear. What about the case when the car collides with the wall. Select the choice that best describes that situation.
 - a) Newton's third law applies only for free bodies so it doesn't apply to the wall.
 - b) The wall repels the force and applies it back on the car doubling the effective force on the car.
 - c) The wall is attached to the floor so although it feels an equal and opposite force the mass is so big that the acceleration is essentially zero.
 - d) The wall's mass is not well defined so the force on it is also not well defined.

App 4: Hitting the Floor

Directions: Use the video to answer the questions below.

1. Which ball feels a greater force?
2. What provides that force?
3. Would you rather have a 5kg ball made of the "happy" or "sad" material dropped on your chest? Explain why.