



Figure 5

A large force exerted over a short time **(a)** causes the same change in the egg's momentum as a small force exerted over a longer time **(b)**.

Now consider a falling egg. When the egg hits a hard surface, like the plate in **Figure 5(a)**, the egg comes to rest in a very short time interval. The force the hard plate exerts on the egg due to the collision is large. When the egg hits a floor covered with a pillow, as in **Figure 5(b)**, the egg undergoes the same change in momentum, but over a much longer time interval. In this case, the force required to accelerate the egg to rest is much smaller. By applying a small force to the egg over a longer time interval, the pillow causes the same change in the egg's momentum as the hard plate, which applies a large force over a short time interval. Because the force in the second situation is smaller, the egg can withstand it without breaking.

SECTION REVIEW

1. The speed of a particle is doubled.
 - a. By what factor is its momentum changed?
 - b. What happens to its kinetic energy?
2. A pitcher claims he can throw a 0.145 kg baseball with as much momentum as a speeding bullet. Assume that a 3.00 g bullet moves at a speed of 1.50×10^3 m/s.
 - a. What must the baseball's speed be if the pitcher's claim is valid?
 - b. Which has greater kinetic energy, the ball or the bullet?
3. A 0.42 kg soccer ball is moving downfield with a velocity of 12 m/s. A player kicks the ball so that it has a final velocity of 18 m/s downfield.
 - a. What is the change in the ball's momentum?
 - b. Find the constant force exerted by the player's foot on the ball if the two are in contact for 0.020 s.
4. **Critical Thinking** When a force is exerted on an object, does a large force always produce a larger change in the object's momentum than a smaller force does? Explain.
5. **Critical Thinking** What is the relationship between impulse and momentum?