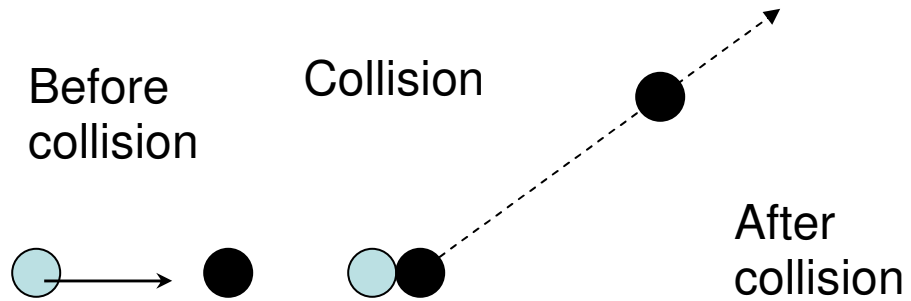
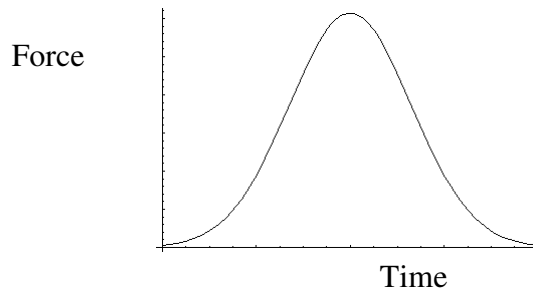


MODULE 6: Linear Momentum

1. Two billiard balls moving as shown collide. After collision, the first ball moves along the path shown. Draw a path showing the recoil of the second ball after collision.



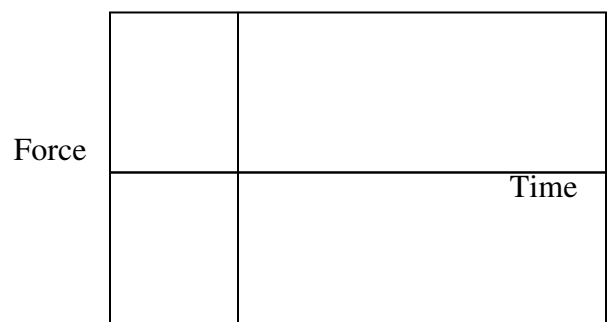
2. The graph below shows the force exerted by the blue billiard ball on the black billiard ball.



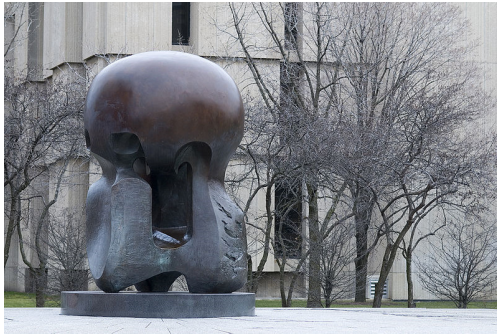
Draw a graph of the force exerted by the black billiard ball on the blue ball as a function of time for the following cases.

- (a) The black ball has the same mass as the blue billiard ball.

- (b) The black ball has twice the mass as the blue ball.



3. The first nuclear reactor was built in 1942 at the University of Chicago, and used carbon nuclei (in graphite) to slow down high speed neutrons produced in the nuclear fission process. A neutron (mass = $1 \text{ u} = 1.661 \times 10^{-27} \text{ kg}$) traveling at a speed of $2.5 \times 10^7 \text{ m/s}$ collides elastically and head-on with a carbon nucleus (mass = 12 u) that is initially at rest.
- (i) If negligible external forces are present during the collision, what are the velocities of the carbon nucleus and the neutron after the collision?



Henry Moore's "Nuclear Energy" near the original Stagg field site (now the site of the Regenstein Library) at the University of Chicago commemorates the nuclear event. Image from Wikipedia.

- (ii) Discuss how such collisions help moderate and keep nuclear reactions "safe". Consider for example that neutron undergoing several such collisions, not all head-on.

4. The driver of a 1250 kg Toyota Prius slams into the back of a Hummer H3 (mass = 2250 kg) that has stopped suddenly. (It's is a good idea to allow several car lengths of space between you and the car in front). The two vehicles slide forward (with their bumpers and their brakes locked) 2 m before coming to a stop. You are investigating the accident and know that the coefficient of kinetic friction between the tires and the road is 0.4. Find the speed at which the Toyota Prius was traveling before the collision.