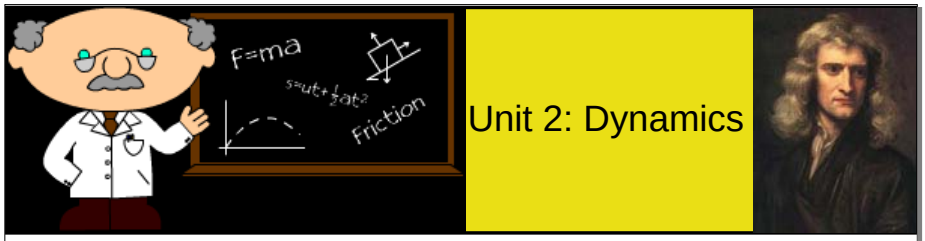



# Unit 2: Dynamics



## 2.3 Newton's Third Law

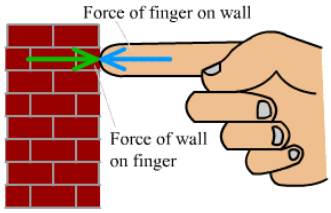
"For every action, there is an equal and opposite reaction."

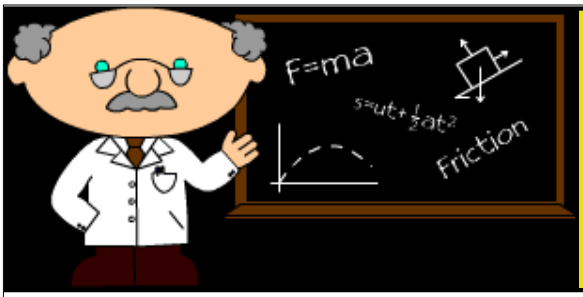
In regards to forces, they never exist alone, they always occur in pairs.

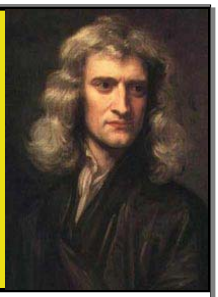

$F_{A\,on\,B} = -F_{B\,on\,A}$

Action force: Object A exerts a force on object B

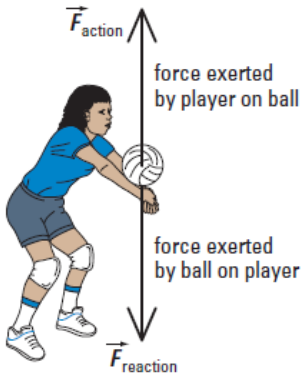
Reaction force: Object B exerts a force on A of equal magnitude but opposite direction.



## Ex.) Action Reaction Forces Acting on Objects in Contact




Let's revisit the scenario of the volleyball player bumping the ball. At the instant that both the ball and the player's arms are in contact, the action force is the upward force that the player exerts on the ball. The reaction force is the downward force that the ball exerts on the player's arms. During the collision, the ball accelerates upward and the player's arms accelerate downward (Figure 3.54).

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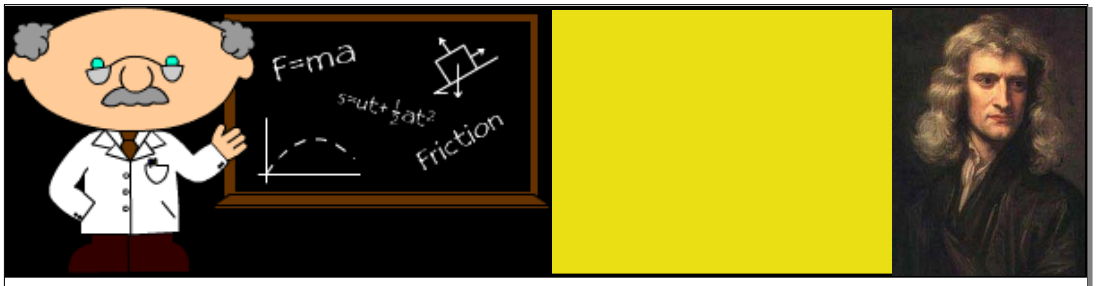
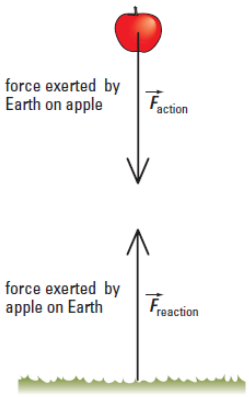



Ex.) Action Reaction Forces Acting on Objects Not in Contact




When an apple falls toward the ground, the action force is the force of gravity that Earth exerts on the apple. The falling apple, in turn, exerts a reaction force upward on Earth. So while the apple is accelerating down, Earth is accelerating up (Figure 3.56).

You see the acceleration of the apple but not of Earth because the inertial mass of the apple is far less than that of Earth. In fact, Earth does accelerate but at a negligible rate because the magnitude of the acceleration is inversely proportional to mass.

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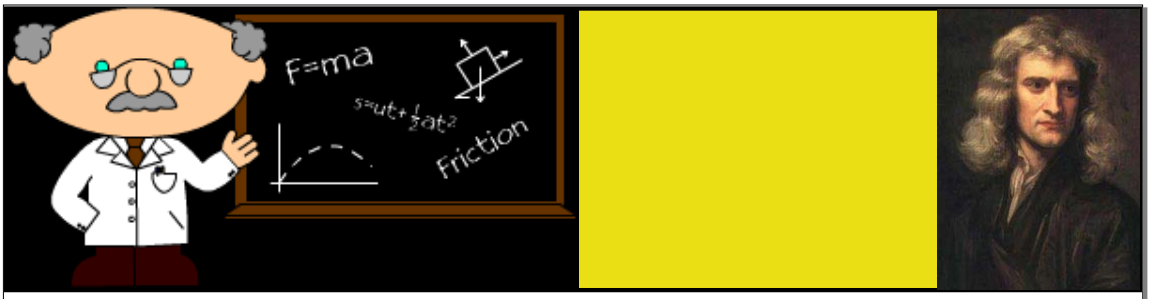
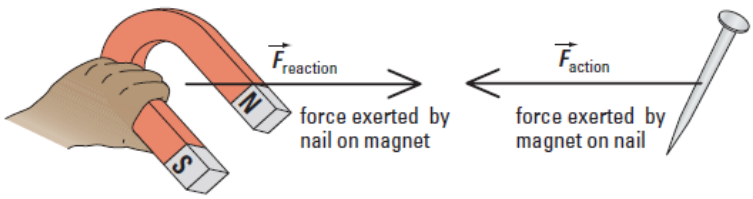
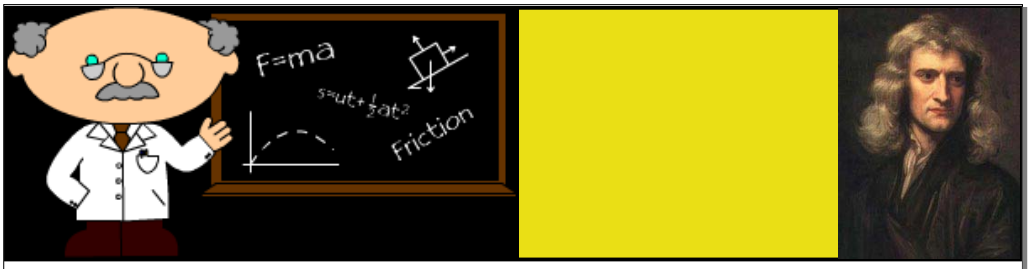



Ex.) When a magnet is brought close to an iron nail, the action force is the magnetic force that the magnet exerts on the nail. The reaction force is the force that the nail exerts on the magnet. So the nail accelerates toward the magnet, and at the same time the magnet is accelerating toward the nail (Figure 3.57).

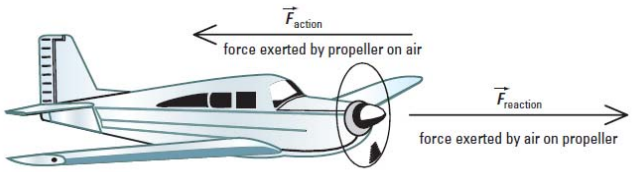


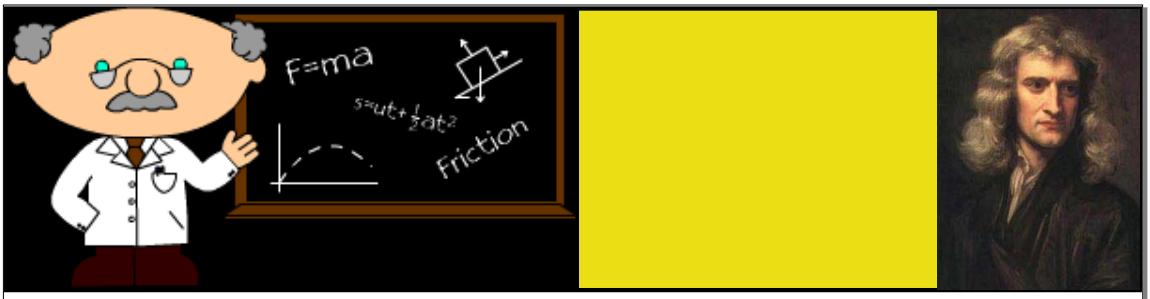



Ex.) The acceleration of many devices such as propeller aircraft can be controlled in midair. To explain how these machines accelerate involves applying Newton's second and third laws.

A propeller airplane can move through air because as the propeller rotates, it exerts an action force on the air, pushing the air backward. According to Newton's third law, the air, in turn, exerts a reaction force on the propeller, pushing the airplane forward (Figure 3.63).

Propeller blades are slanted so that they scoop new air molecules during each revolution. The faster a propeller turns, the greater is the mass of air accelerated backward and, by Newton's second law, the force exerted by the air on the propeller increases.




Read: example 3.12 on page 164

Questions: Two practice problems following 3.12

- Chart / Graphic Organizer of Newton's Laws.