Chapter 5 Newton's Third Law of Motion
Action and Reaction Pairs

1. In the example below, the action-reaction pair is shown by the arrows (vectors), and the action-reaction described in words. In a through g, draw the other arrow (vector) and state the reaction to the given action. Then make up your own example in h.

Example:

- Fist hits wall
  - Head bumps ball
    - Windshield hits bug
      - a. Ball bumps head
      - b. Bug hits windshield

- Bat hits ball
  - Hand touches nose
    - Hand pulls on flower
      - c. Ball hits bat
      - d. Nose touches hand
      - e. Flower pulls on hand

- Athlete pushes bar upward
  - Compressed air pushes balloon surface outward
    - f. Bar pushes athlete downward
    - g. Balloon pushes inward
    - h. Hand pushes on door
    - Door pulls on hand

2. Draw arrows to show the chain of at least six parts of action-reaction forces below.

---

YOU CAN'T TOUCH WITHOUT BEING TOUCHED—NEWTON'S THIRD LAW

Draw it!
Chapter 5  Newton’s Third Law of Motion
Interactions

1. Nellie Newton holds an apple weighing 1 newton at rest on the palm of her hand. The force vectors shown are the forces that act on the apple.

   a. To say the weight of the apple is 1 N is to say that a downward gravitational force of 1 N is exerted on the apple by Earth [her hand].

   b. Nellie’s hand supports the apple with normal force N, which acts in a direction opposite to W. We can say N [equals W] [has the same magnitude as W].

   c. Since the apple is at rest, the net force on the apple is zero [nonzero].

   d. Since N is equal and opposite to W, we cannot say that N and W comprise an action-reaction pair. The reason is because action and reaction always [act on the same object] [act on different objects], and here we see N and W [both acting on the apple] [acting on different objects].

   e. In accord with the rule, “If ACTION is A acting on B, then REACTION is B acting on A,” if we say action is Earth pulling down on the apple, reaction is the apple pulling up on Earth [N, Nellie’s hand pushing up on the apple].

   f. To repeat for emphasis, we see that N and W are equal and opposite to each other [and comprise an action-reaction pair] but do not comprise an action-reaction pair.

   To identify a pair of action-reaction forces in any situation, first identify the pair of interacting objects involved. Something is interacting with something else. In this case the whole Earth is interacting (gravitationally) with the apple. So Earth pulls downward on the apple (call it action), while the apple pulls upward on Earth (reaction).

   Simply put, Earth pulls on apple (action); apple pulls on Earth (reaction).

   Better put, apple and Earth pull on each other with equal and opposite forces that comprise a single interaction.

   g. Another pair of forces is N (shown), and the downward force of the apple against Nellie’s hand (not shown). This force pair is [isn’t] an action-reaction pair.

   h. Suppose Nellie now pushes upward on the apple with a force of 2 N. The apple [is still in equilibrium] accelerates upward, and compared to W, the magnitude of N is [the same] twice [not the same, and not twice].

   i. Once the apple leaves Nellie’s hand, N is zero [twice the magnitude of W], and the net force on the apple is [zero] only W [still W − N, which is a negative force].