INTEGRATED SCIENCE A

Newton's Third Law

A force is a push or a pull that acts upon an object as a result of its interaction with another object. Forces result from interactions! Some forces result from contact interactions (normal, frictional, tensional, and applied forces are examples of contact forces) and other forces are the result of action-at-a-distance interactions (gravitational, electrical, and magnetic forces). According to Newton, whenever objects A and B interact with each other, they exert forces upon each other. When you sit in your chair, your body exerts a downward force on the chair and the chair exerts an upward force on your body. There are two forces resulting from this interaction - a force on the chair and a force on your body. These two forces are called action and reaction forces and are the subject of Newton's third law of motion. Formally stated, Newton's third law is:

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

The statement means that in every interaction, there is a pair of forces acting on the two interacting objects. The size of the forces on the first object equals the size of the force on the second object. The direction of the force on the first object is opposite to the direction of the force on the second object. Forces always come in pairs - equal and opposite action-reaction force pairs.

Examples of Interaction Force Pairs

A variety of action-reaction force pairs are evident in nature. Consider the propulsion of a fish through the water. A fish uses its fins to push water backwards. But a push on the water will only serve to accelerate the water. Since forces result from mutual interactions, the water must also be pushing the fish forwards, propelling the fish through the water. The size of the force on the water equals the size of the force on the fish; the direction of the force on the water (backwards) is opposite the direction of the force on the fish (forwards). For every action, there is an equal (in size) and opposite (in direction) reaction force. Action-reaction force pairs make it possible for fish to swim.

Consider the flying motion of birds. A bird flies by use of its wings. The wings of a bird push air downwards. Since forces result from mutual interactions, the air must also be pushing the bird upwards. The size of the force on the air equals the size of the force on the bird; the direction of the force on the air (downwards) is opposite the direction of the force on the bird (upwards). For every action, there is an equal (in size) and opposite (in direction) reaction. Action-reaction force pairs make it possible for birds to fly.

Choose the best answer for each question from the choices below.

1. Newton's 3rd Law states…

A. Objects in motion stay in motion and objects at rest stay at rest
B. Force is equal to mass times acceleration
C. For each action there is an equal and opposite reaction

2. An archer shoots an arrow. The action force is the bowstring against the arrow. The reaction force is…

A. Air resistance against the bow
B. Arrow's push against the bowstring
C. Grip of the hand on the bow

3. A player hits a ball with a bat. The action force is the impact of the bat against the ball. The reaction force is…

A. The grip of the player's hands on the ball
B. The air resistance on the ball
C. The force of the ball against the bat

4. A baseball player bats a ball with a force of 1,000 N. The ball exerts a reaction force against the bat of… **A**. Less than 1,000 N **B**. More than 1,000 N **C**. 1,000 N

5. A person is attracted toward the center of the Earth by a 500 N gravitational force. The force that the Earth is attracted toward the person is…

A. 500 N B. Much less than 500 N C. Much more than 500 N

FILL IN THE BLANKS

6. Forces result from _____

7. The two forces are called action and _____

8. The size of the force on the first object, _____ the force on the second object.

9. Forces always come in _____.

10. A swimmer pushes back on the water. The reaction force is_____

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