Connecting Motion with Forces

What is a force?

For example:

1) Push a door open
2) Stretch a rubberband
3) Squeeze a piece of clay

In each of the above cases, you are applying a force. A force is a push or pull one body exerts on another. Sometimes, the effects of a force are obvious, such as when a moving car crashes into a stationary object, such as a tree. Other forces aren't as noticeable. Can you feel the force the floor exerts on your feet?

List all the forces you might exert or encounter in a typical day.

eg: pushing, pulling, stretching, squeezing, bending, falling

What happens to the objects in your list that have forces exerted on them? If an object is moving, does the force change the object's velocity? Think of a swinging bat hitting a softball. The ball's velocity does change upon impact. But force doesn't always change velocity. Think about a game of tug-of-war with a dog. You plant yourself firmly and lean back to push against the ground, causing the ground to push back on you.

Your dog does the same. If you don't move forward or backward, the force of the dog pulling you forward must be balancing the force of the ground pushing you back. Forces on an object that are equal in size and opposite in direction are called balanced forces.

Now, what happens if your feet hit an icy spot on the ground? Your feet slip, and the ground can't exert as much force back on you. The forces of the dog pulling you forward and the ground pushing you back become unbalanced, and there is a net force on you. A net force on an object always changes the velocity of the object. When the dog pulls you forward with more force than the ground pushes back on you, you accelerate in the direction of the greater force.

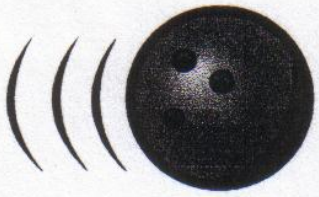
Remember that velocity involves both speed and direction. A net force acting on an object will change its speed, direction or both. In the tug of war, the net force on you causes both your speed and direction to change.

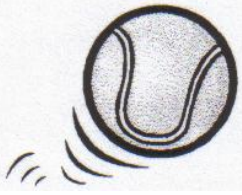
Inertia and Mass

Imagine a hockey puck sliding across an ice rink. Its velocity hardly changes until it hits something, like a wall,

the net, or a hockey stick. The velocity of the puck is constant, and its acceleration is zero until it hits something that alters its speed or direction. The sliding puck demonstrates the property of inertia. Inertia is the tendency of an object to resist any change in its motion. If an object is moving, it will keep moving at the same speed and in the same direction unless an unbalanced force acts on it. In other words, the velocity of the object remains constant unless a force changes it. If an object is at rest, it tends to remain at rest. Its velocity is zero unless a force makes it move

Would you expect a tennis ball to have the same inertia as a bowling ball? Why would there be a difference? The more mass an object has, the greater its inertia is. Mass is the amount of matter in an object, and a bowling ball has more mass than a tennis ball. So, the bowling ball would have greater inertia than the tennis ball. You wouldn't change the velocity of a bowling ball very much by swatting it with a racket, but you could easily change the velocity of the tennis ball. Because the bowling ball has greater inertia, a much greater force would be required to change its velocity.





Newton's First Law

An object moving at constant velocity keeps moving at that velocity unless a net force acts on it. If an object is at rest, it stays at rest unless a net force acts on it.

Friction

Inertia causes an object that is moving at a constant velocity to keep moving at that velocity until a net force acts on it. But you know that if you slide a book across a long table, it eventually slows down and stops. Why?

An unseen force is acting between the book and the table. The force is friction. Friction is the force that opposes motion between two surfaces touching each other. Would you expect more friction between an oily floor and a leather-soled shoe or between a rough sidewalk and the bottom of a tennis shoe? The amount of friction depends on two factors: the kinds of surfaces and the forces pressing the surfaces together.

Life Without Friction

If there were no friction, your life would be much different. You wouldn't be able to walk or hold things between your fingers. Your shoes would fall off. Friction between the soles of your shoes and the floor makes it possible for you to walk. You can hold your pencil thanks to friction. Your shoelaces stay tied thanks to friction.