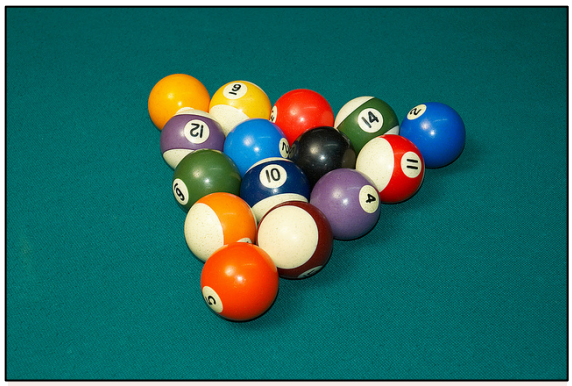
Energy and Collision

Reflect

When objects collide, the contact forces transfer energy that changes the objects' motions. Objects have kinetic energy as they move, and they have potential energy when they are at rest. When two objects collide, they transfer these energies to each other.

potential energy: the energy possessed by an object as a result of its position

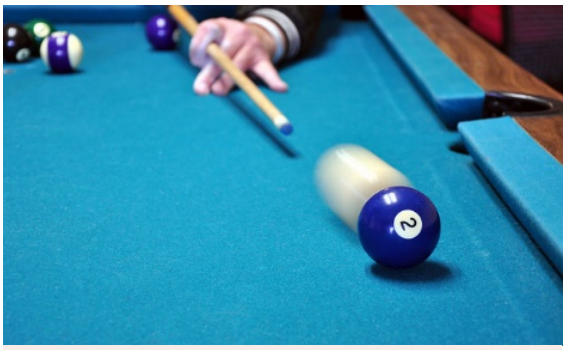


These billiard balls all have potential energy.

When all of the objects are sitting still, they have potential energy. Without a collision (an external force) the objects will not move. The collision of another ball into the group of billiard balls in the picture below will carry its kinetic energy into the group and transfer that energy to all of the ones sitting still. The balls that are sitting still exchange some of their potential energy to the ball that hit them. The harder this group of billiard balls is hit the more energy is transferred to them and the more they will speed up and move.

collision: the meeting of objects in which each exerts a force upon the other

kinetic energy: the energy possessed by an object as a result of its motion

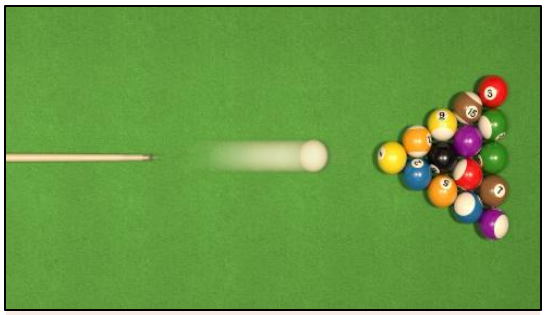


The moving cue ball has kinetic energy and the still blue ball has potential energy.

As the cue ball races toward the other billiard ball that is sitting still, it has kinetic energy. It will travel in that direction until another force acts upon it. When it strikes the blue ball, the impact will allow the energy from the cue ball to move into the blue ball. The cue ball will slow down and sometimes move in another direction. The blue ball will change its motion and start rolling in the direction in which it was propelled (or pushed). Where we observed one ball not moving at all, the energy transfer from the collision creates its movement. On the other hand, where we observed one ball racing towards the other, the energy transfer from the collision slows it down and changes its direction.

What Do You Think?

What do you think is going to happen when the cue ball impacts the group of billiard balls? There will definitely be a transfer of energy. Can you decide what kind of energy the group of waiting balls has? In which direction will they go? What forces are acting upon the balls as they sit there? What forces are acting upon them as they begin to move? There are many trick shots that you can perform when playing pool. Being a master at manipulating the collision between billiard balls is a skill that many players try to accomplish. You can do it too! Just master the transfer of energy and you will be set!



The cue ball is rushing towards the other billiard balls with kinetic energy.

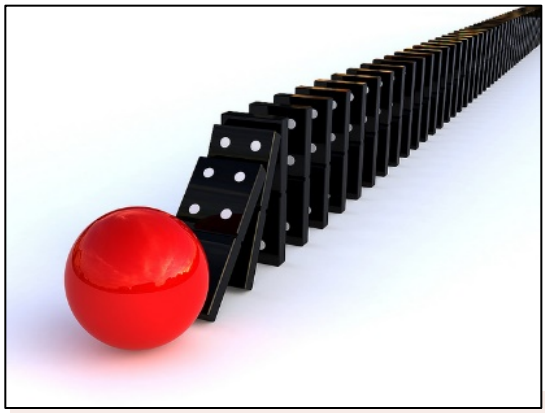
Look Out!

The collision of two objects is not the only force acting on objects. Because forces are not always visible, it is sometimes easy to forget that they exist. All of these forces are usually happening at one time, and they all impact the way objects behave on our planet.
Look at the picture of the tennis player (left). Right now the force of gravity is acting upon him, his racket, and the tennis ball. Friction is slowing him down on the court and keeping him standing (instead of slipping and falling). His racket is moving towards the ball and has kinetic energy. The ball is moving towards his racket with kinetic energy. When energy is transferred between two objects that have kinetic energy, acceleration is likely to happen. The elasticity (spring) in his tennis racket strings will give the ball even more energy to speed back across the tennis court.

Look Out!

Elastic collisions, such as the one occurring between the springy tennis racket strings and the tennis ball, tend to make both objects have a change in direction. The racket will fly backwards in the same way the ball was moving before it hit the racket. The ball will bounce back off the racket and move in the direction that the racket was swinging. No kinetic energy is lost in elastic collisions; it just transfers from one object to another. In inelastic collisions, some of the kinetic energy is lost to different forms of energy, such as heat caused by friction. Some examples of inelastic collisions would be one object not moving while the other changes direction, such as the tennis ball just bouncing off of the ground or the objects sticking together (such as in a car crash). In the example of the tennis ball hitting the ground, some of the kinetic energy gets changed into heat due to friction from the tennis ball rubbing on the ground. This causes the tennis ball to lose speed.

Try Now



Energy is always conserved.

You can use the transfer of energy that happens during collisions to create fun designs and neat tricks. Start by setting up dominoes in interesting patterns (try spelling your name). Make sure your domino trail has a starting point and an ending point. Then roll a small ball into the first domino and let its kinetic energy transfer to the first domino in the pattern. You will be able to watch the energy move through the pattern as the dominoes collide. How can you change the pattern? Does anything change the direction of the dominoes? What would happen if you placed another object (such as another ball) in the pattern?

What Do You Think?

Imagine standing at the end of a bowling lane right behind the pins. The picture below shows how the ball is being rolled toward you.

The pins at the end of the lane stand in a triangular formation. Use the table below to decide what types of energy exist for each situation and what will happen to the energy from the bowling ball as it strikes the pins.

Bowling Ball		Bowling Pins		Outcome
Phase	**What type of energy is present?**	**Phase**	**What type of energy is present?**	**What is happening to the objects and their energy?**
Leaves your hand		Waits at the end of the lane		
Strikes the pins		Pins begin to fall		
Sits in the gutter		Are swept away by the pin arm		

Connecting With Your Child

Energy and Collision at Home

This activity will help your child explore the transfer of energy between objects that are sitting still and moving as they collide.

The only materials you will need are two balls and different types of flat surfaces. You may use any surface on which to roll the balls; however, the smoother the surface, the more movement you will observe in the balls as they roll towards each other. The balls can have different masses and size but you will want to make sure that they do not bounce as you begin to roll them. Before each situation, have your child predict what each ball will do after the collision.

1. Keep one ball still and roll the other ball towards it. Observe both balls' accelerations and directions of travel after the collision. How does this compare with your prediction?
2. Roll both balls towards each other from opposite directions. Observe both balls' acceleration and direction of travel after the collision. How does this compare with your prediction? Which way did both balls move after the collision?
3. Roll both balls in the same direction (one after another). You should roll one ball slowly and the other at a faster speed. Observe both balls' accelerations and directions of travel after the collision. How does this compare with your prediction? Did the slower ball accelerate after the collision? Which way did the balls move after the collision?

How did the position of the balls affect the direction and movement after they impacted each other? Objects of different masses and varied velocities have different amounts of momentum. The varied momentums change the behavior and direction of the objects with which they come into contact as the energy transfer happens.

Here are some questions to discuss with your child:

- Which forces acted on the balls?
- What is acceleration?
- Why did one ball stop and the other roll when they hit each other?
- Does the acceleration of the balls change how they both react when they collide?