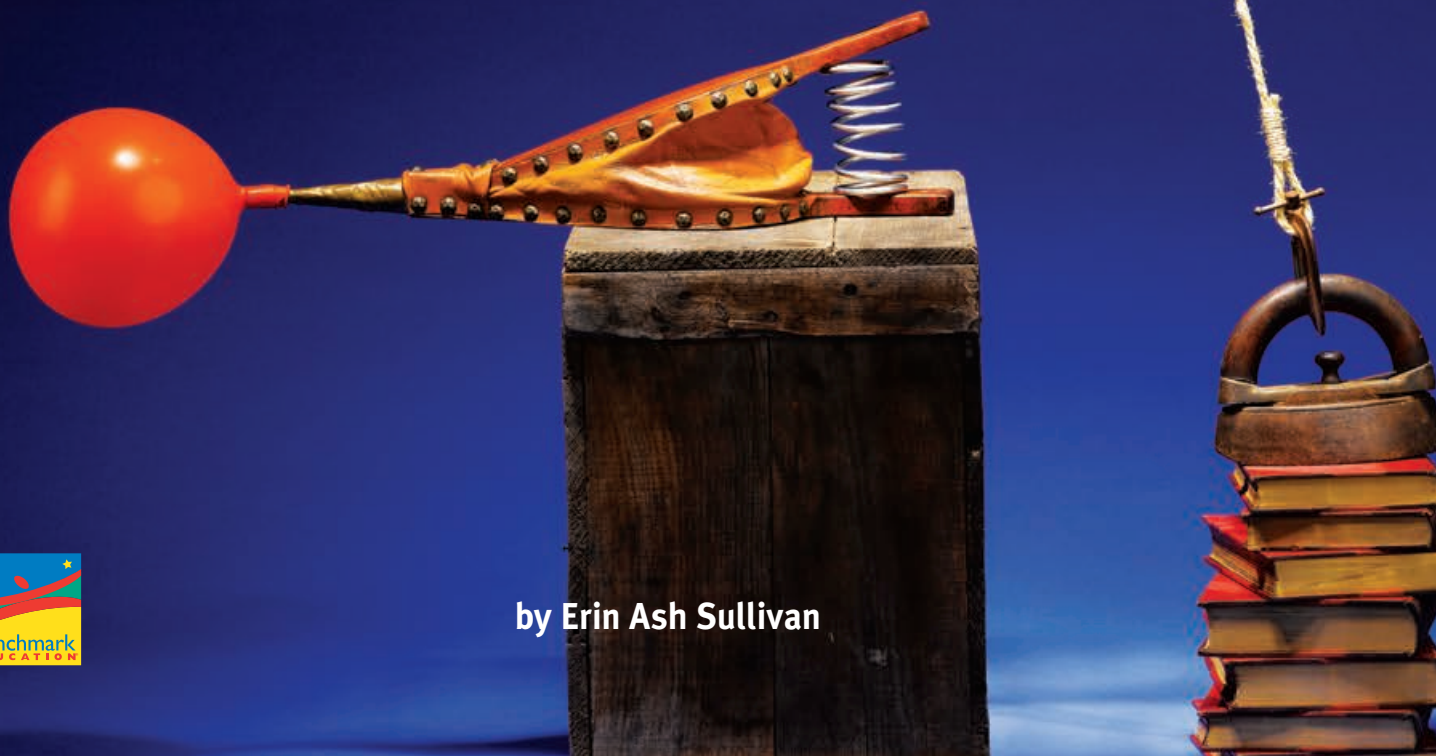


CHAIN REACTIONS

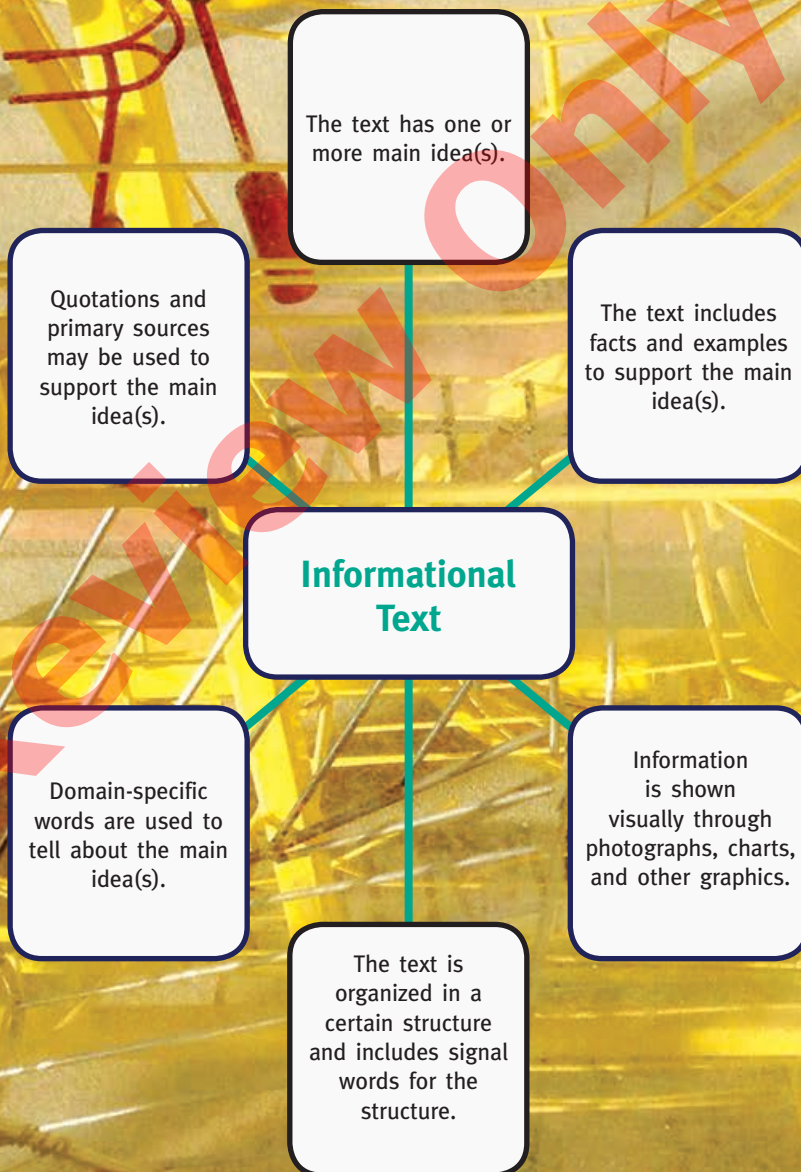
How and why do chain reactions occur?



Level	T/50
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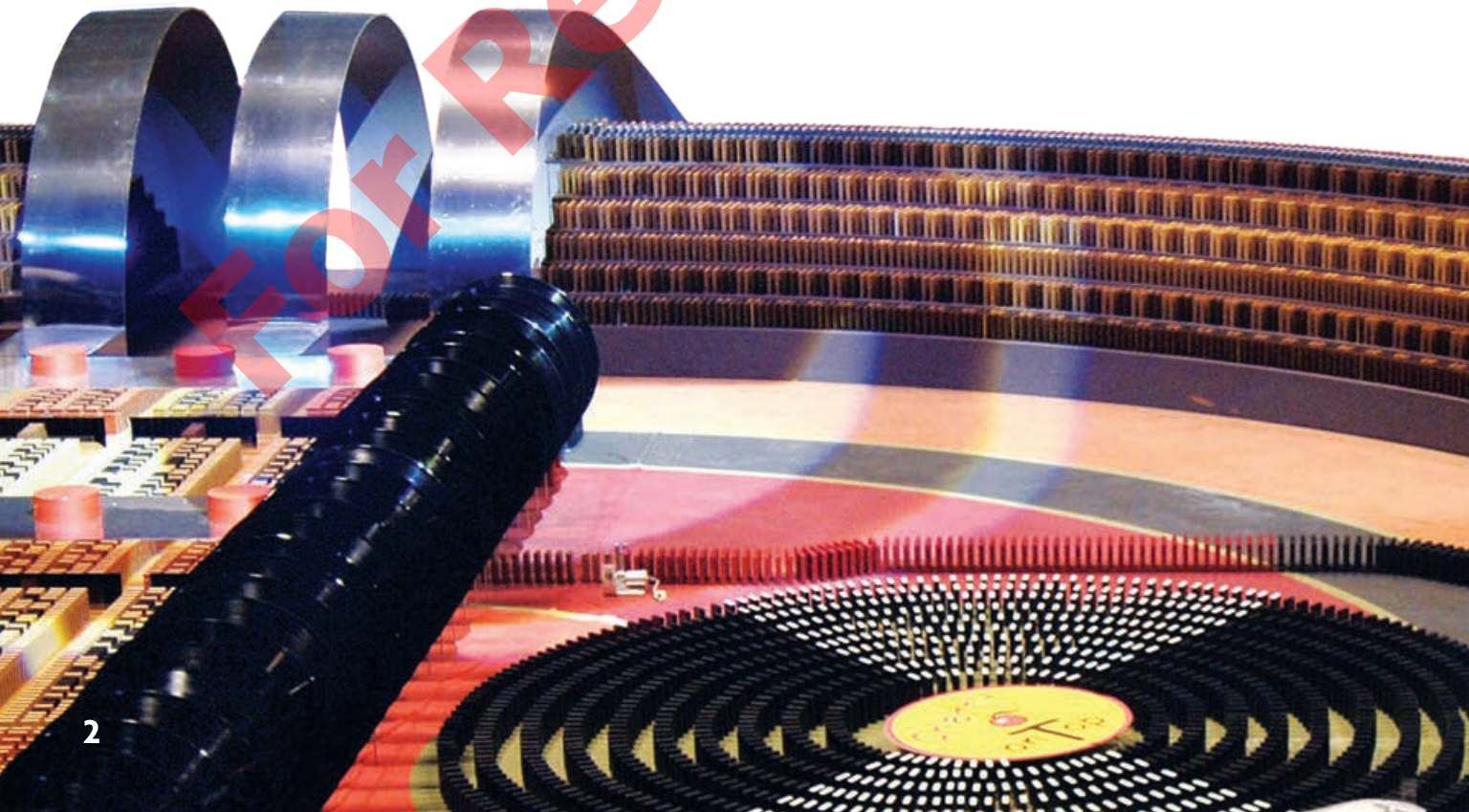
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OBJECTS IN MOTION

During the summer of 2017, a team of nineteen builders from five different countries met in Taylor, Michigan. This group of builders had come together to do something remarkable—their goal was to break a world record.

The team spent over 1,200 hours building an amazing domino design that took up the entire floor of a high school gym. The team's theme was “Game On,” and their design showed board games, video games, and sports. The finished design used more than 250,000 dominoes!





◀ Zeal Credit Union's Incredible Science Machine team

On July 30, the team put their dominoes into motion. A small ball rolled down a ramp and knocked into the first domino, causing it to fall. As this domino fell, it knocked over the next domino. That domino knocked over a third domino, and so on.

Nearly fifteen minutes later, all 250,000 dominoes had toppled. The Zeal Credit Union's Incredible Science Machine team had broken the record for knocking down the most dominoes in the United States.

A **domino show**, like the one just described, is one example of a **chain reaction**. A chain reaction is a series of events in which each event is caused by the event that happened just before.

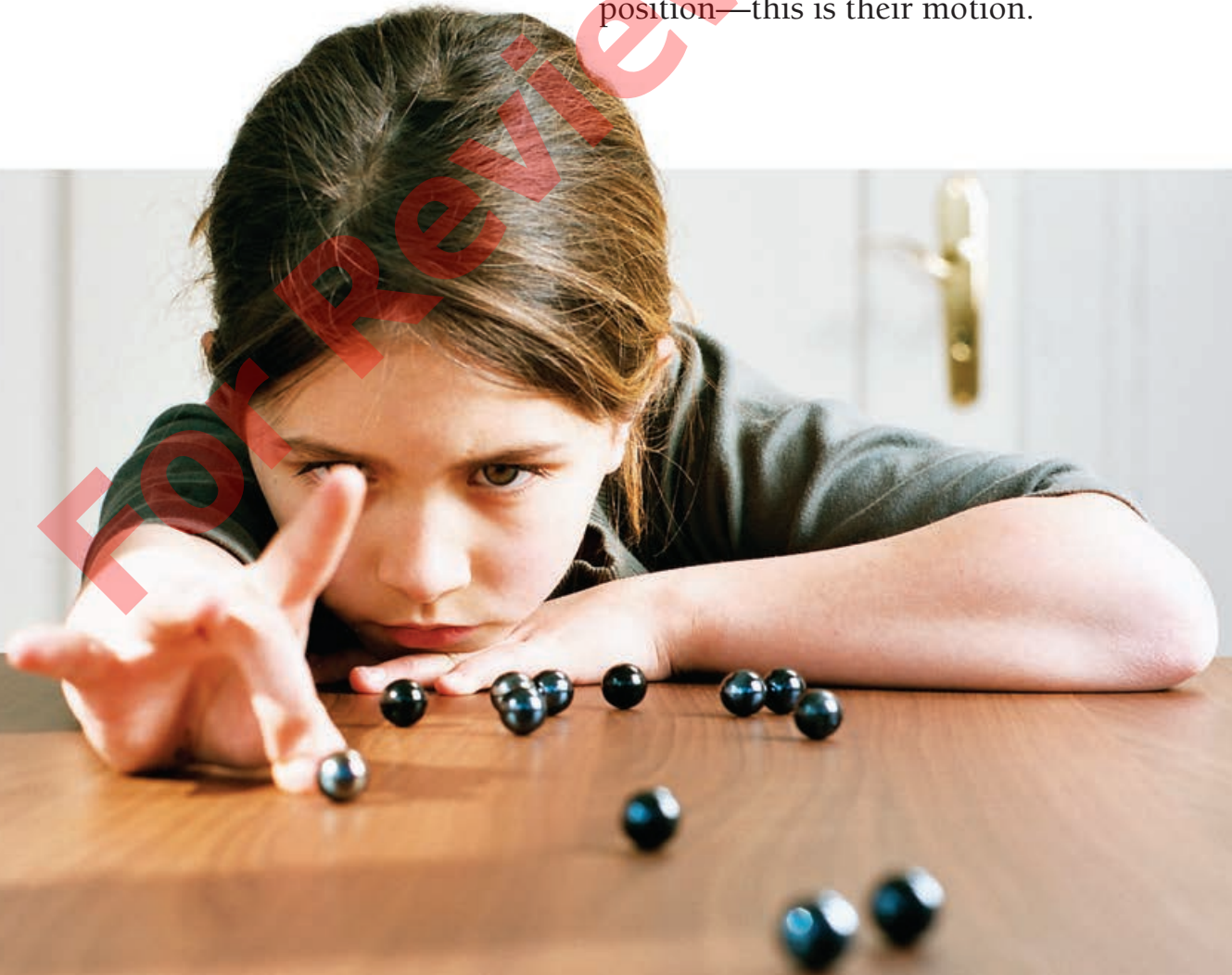


The team's record-breaking domino structure was so large that this photo can show only part of it!

MOTION, FORCE, AND ENERGY

Domino shows, like the record-breaking one from July 2017, work because of physics. Physics is the study of motion, force, and energy.

Motion is the way an object changes position over time. The dominoes in a domino show change from an upright position to a down position—this is their motion.





▼ A push is a force.

Force is the push or pull on an object. Force can cause an object to move, and force can also stop an object that is already in motion.

Force can also change an object's direction or **speed**. Speed is a term used to describe the rate of motion of an object. In general, the greater the force acting on an object, the faster the object will move.

Imagine someone taps the first domino in a domino show. The force that happens when a person pushes the first domino is important because it begins the chain reaction.

The other important force in a domino show is **gravity**. Gravity is the force that pulls all objects toward Earth. When a person pushes the first domino, gravity causes the domino to tip over. If the second domino is close enough to the first, the first domino will cause the second domino to tip over. The second domino will cause the third domino to tip over, and so on.

When force is applied to an object and something is moved over a distance in the direction of that force, that is called **work**.

◀ A marble with greater speed will hit another marble with more force than if it had a slower speed.

Types of Energy

Energy is the ability to do work, such as move an object. Energy comes in many forms. One form is motion. Energy can also take the forms of heat, sound, or light.

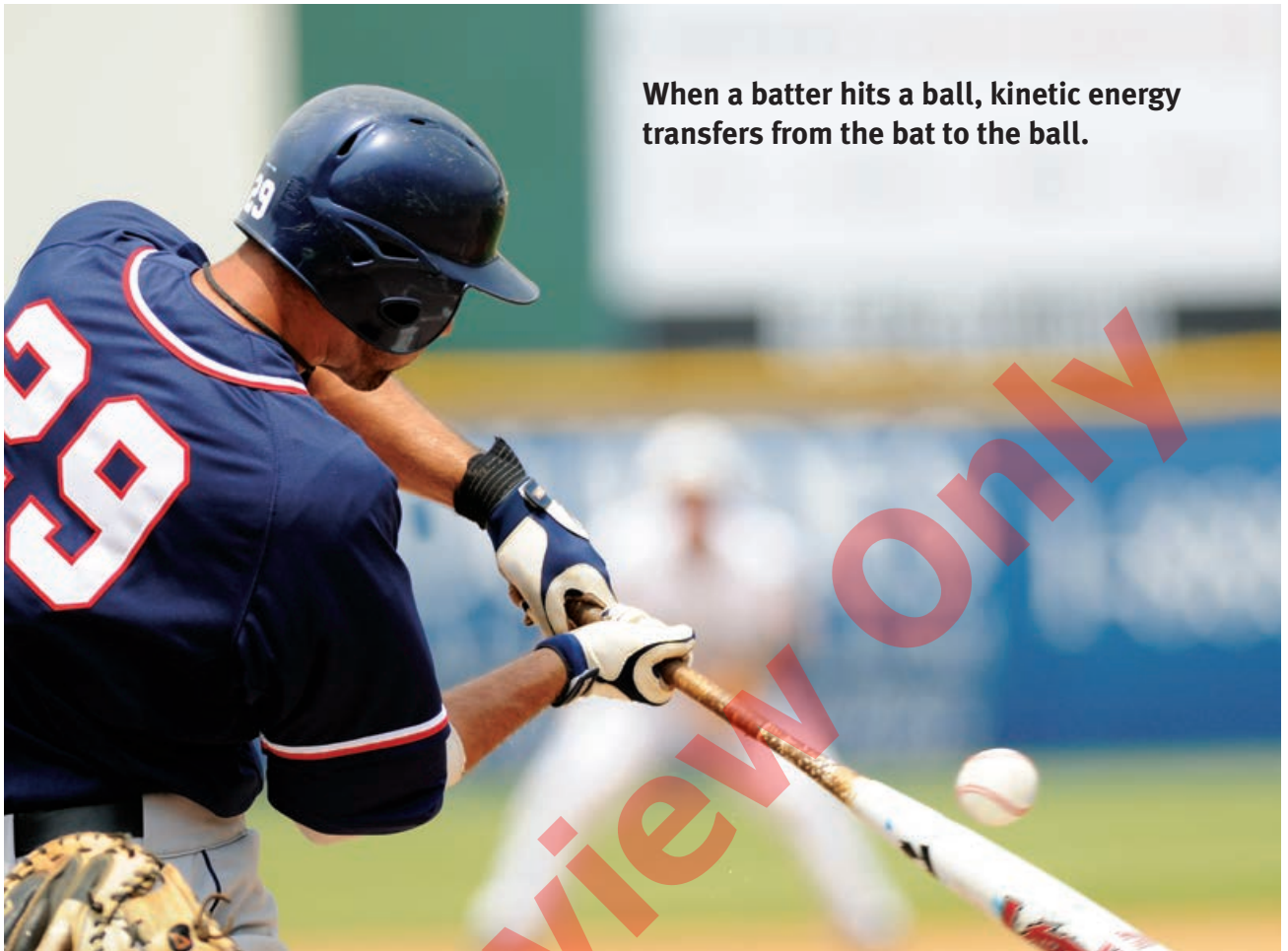
Potential energy is the energy an object possesses because of where it is located. When a person lifts a domino into its upright position, its potential energy increases. When a person places a marble at the top of a ramp or presses down on a spring, the potential energy increases. Think

about when the Zeal Credit Union's Incredible Science Machine team set up 250,000 dominoes. They created a lot of potential energy!

Kinetic energy is the energy an object possesses when it moves. For example, if a person removes his or her finger from a pushed-down spring, the spring will release and expand. This movement is an example of kinetic energy. A domino falling forward also has kinetic energy.

The skateboarders have more potential energy at the top of the ramp than at the bottom.





When a batter hits a ball, kinetic energy transfers from the bat to the ball.

Energy Transfer

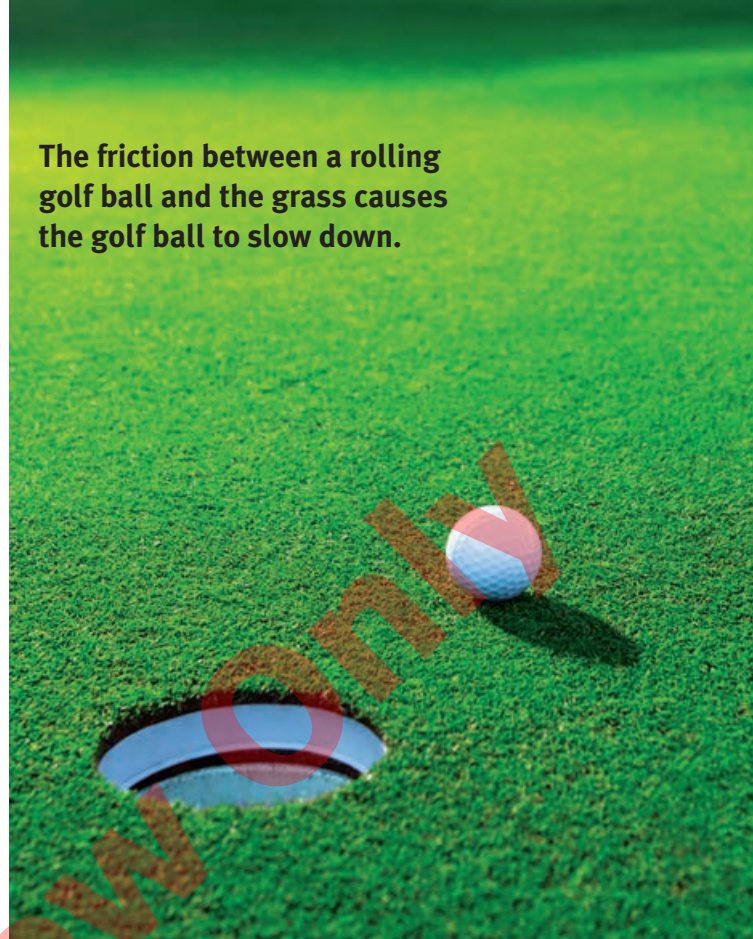
A **collision** occurs when two objects make contact and exert force on each other. The collision causes energy to transfer from one object to the other object. This transfer of energy causes the motion of both objects to change. For example, when a batter hits a ball, the speed and direction of the ball change. The speed and direction of the bat are also affected.

A domino show relies on every collision. The kinetic energy of the first domino is transferred when it collides with the second domino. The kinetic energy of the second domino is transferred when it collides with the third domino, and so on.

In a chain reaction, not all of the energy is converted into motion. A tiny amount of energy is turned into sound energy. For example, the *click-click* noise the dominoes make is sound energy.

In a chain reaction, an even smaller amount of energy is turned into heat. **Friction** is the force that occurs when two objects move against each other. Friction causes objects in motion to slow down. Friction causes some energy to be turned into heat energy. Think of what happens when hands rub together: the friction of rubbing hands causes heat.

The friction between a rolling golf ball and the grass causes the golf ball to slow down.



Newton's Cradle

There are many everyday examples of potential and kinetic energy as well as energy transfer.

One example is a toy called a Newton's Cradle. It was named after the scientist Sir Isaac Newton.

When a person holds up a ball at one end of a Newton's Cradle, that ball's potential energy increases. When the ball is released, it moves, and the ball's potential energy is converted into kinetic energy.

When the ball collides with another ball, it transfers some of its energy to the second ball.

A person can watch as the energy moves through all the balls. The end result is that none of the balls in the middle move and only the final ball on the opposite end moves.

Biography

Sir Isaac Newton

Sir Isaac Newton lived in England from 1643 to 1727. He was a mathematician and an astronomer. He was especially curious about what caused the moon to orbit, or travel in a circular path, around Earth.

Over many years, he made close observations of the night sky. His research led him to become the first person to describe the law of gravity and the laws of motion. His work led to the formation of a whole new area of scientific study called physics.



- ▼ In a Newton's Cradle, some energy is turned into sound energy. Over time, the balls will slow down and lose force because of friction.

