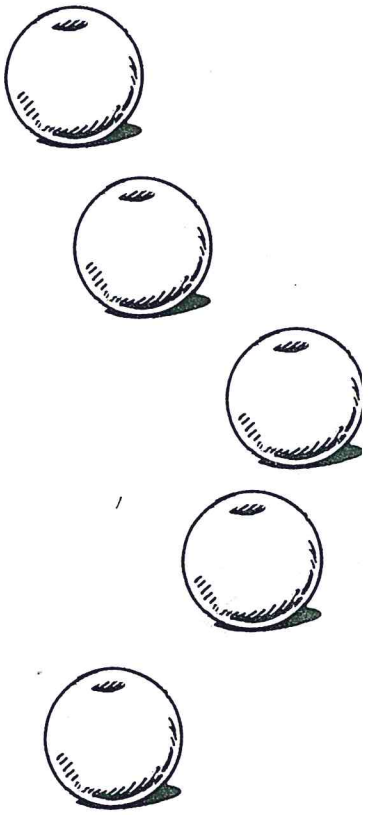
Name _____ Date _____

Selection 7

A Law of Motion

Sir Isaac Newton was an English mathematician and scientist who lived in the 1600s and 1700s. He published his three laws of motion, which describe how forces affect the motion of an object, in 1687. You can demonstrate one of Newton's laws of motion with an apparatus called a Newton's cradle. The cradle will show that things at rest tend to stay at rest until acted on by an outside force. A Newton's cradle also demonstrates what scientists call the "Principle of Conservation of Energy." This means that energy is never created or destroyed. Energy can change from one form to another, but the total amount of energy stays the same.



It is easier to understand these scientific principles if you use your own Newton's cradle. You need only a few materials to build one.

- 1 ruler marked in inches
- 1 pencil or dowel rod
- scissors
- 5 paper clips
- 5 8-in. pieces of fishing line
- 5 wooden beads

Once you have your materials, you are ready to begin building your Newton's cradle. Here's how.

First, use your ruler to make five marks on the pencil or dowel rod. The marks should be exactly one inch apart. Be sure the third mark is in the center of the pencil or dowel rod.

Second, use the scissors to score, or cut, a ring around each mark on the pencil or dowel rod. The ring should go all the way around the pencil or rod. Handle the scissors carefully so that you do not cut your skin.

Third, tie a paper clip to one end of each piece of fishing line. Place each paper clip in exactly the same place on each line.

Fourth, thread one piece of fishing line through the hole in each bead. Each bead will rest on a paper clip.

Fifth, tie each piece of fishing line around the scored rings on the pencil or dowel rod. The beads must line up exactly and hang evenly.

Use one hand to hold the pencil or rod horizontally. Pull the first bead on one end back. Then release it gently. Observe what happens. The bead you release exerts a force on the other beads.

Now consider the Principle of Conservation of Energy to examine what happens to the beads on your Newton's cradle. Before you released the bead, the bead had one kind of energy called potential energy. When you let the bead fall, the potential energy changed into another kind of energy called kinetic energy. Kinetic energy is the energy of motion.

Wait. There are still more transformations in energy. When the first bead hit the second bead, what did you hear? You heard a click. A click is sound energy. Now think about what happens when two things rub together. For example, if you rub your hands together, can you feel your hands getting warmer? The kinetic energy in your hands changes to heat energy. The same thing happens with the beads on your Newton's cradle. As the first bead hits the second bead, energy moves through the beads to the bead at the other end. The bead lifts, swings back, and hits the line of beads. Each time a bead hits another bead, kinetic energy changes to sound and heat energy. Eventually, the kinetic energy changes completely to sound and heat, and the beads stop moving. But don't expect this to happen quickly. Since the changes of energy are small, it takes some time for the beads to stop moving.

Now you know how to build a Newton's cradle. You also know how to use the cradle to demonstrate some interesting scientific principles. Try making other Newton's cradles. Use different sizes of dowel rods and string. Change the number of beads, or use metal beads. You might even want to demonstrate your super science skills in front of a group of people.

Name _____ Date _____

A **Circle the correct answer for each question.**

1. A Newton's cradle demonstrates that things stay at rest unless acted on by an
   - **a.** inside force.
   - **b.** energetic force.
   - **c.** outside force.
   - **d.** overhead force.

2. Although energy can change form, the total amount of energy
   - **a.** grows stronger.
   - **b.** decreases in strength.
   - **c.** slowly disappears.
   - **d.** stays the same.

3. The energy of a bead in a Newton's cradle changes from potential energy into kinetic energy because
   - **a.** the bead is in motion as it falls.
   - **b.** the bead releases energy.
   - **c.** the bead makes a clicking sound.
   - **d.** the bead was hanging evenly with the other beads.

4. Read this sentence from the eleventh paragraph.

   There are still more transformations in energy.

   Which word in the tenth paragraph ***best*** helps the reader understand what "transformations" means?
   - **a.** *examine*
   - **b.** *released*
   - **c.** *happens*
   - **d.** *changed*

5. Read this detail from the eleventh paragraph.

   Each time a bead hits another bead, kinetic energy changes to sound and heat energy.

   Which of these statements from the selection does this detail ***best*** support?
   - **a.** *Energy can change from one form to another, but the total amount of energy stays the same.*
   - **b.** *The cradle will show that things at rest tend to stay at rest until acted on by an outside force.*
   - **c.** *This means that energy is never created or destroyed.*
   - **d.** *Since the changes of energy are small, it takes some time for the beads to stop moving.*

6. What is the eleventh paragraph ***mainly*** about?
   - **a.** how kinetic energy can change to heat energy in certain circumstances
   - **b.** how energy changes when a Newton's cradle is in motion
   - **c.** how the beads on a Newton's cradle move when the apparatus is set in motion
   - **d.** how changes in energy happen all the time, but slowly and gradually

Name _____ Date _____

C **Synonyms are words that mean the same or almost the same. Circle the two synonyms on each line.**

1.	bleached	blackened	cruel	darkened
2.	ancient	potential	experienced	possible
3.	exert	apply	discard	prepare
4.	discover	show	hide	demonstrate
5.	underneath	distant	outside	exterior
6.	emerge	retreat	appear	fade
7.	attract	continue	reveal	sustain
8.	dispute	participate	oppose	survive
9.	industrious	subdued	panicked	hardworking
10.	rebellion	dismay	protest	celebration
11.	theory	menu	degree	idea

D **Choose a word from below to complete each sentence. Some words will not be used.**

flora	apparatus	principle
specimen	conserve	demonstrate
species	catalog	dowel
cargo	kinetic energy	specific

1. An instrument or tool is an _____.

2. The plants in a location are the _____.

3. A sample from a group for scientific study is a _____.

4. A group of similar organisms is a _____.

5. A rule or law is a _____.

6. To make an organized list of items is to _____.

7. The energy of motion is _____.

8. A long, wooden rod is called a _____.

9. A load carried by a plane or a ship is called _____.

10. To show how something works is to _____.

Name _____ Date _____

E **Another of Newton's laws says that "for every reaction there is an equal and opposite reaction." This could be called the law of cause and effect. It means that for every action there is a result, or consequence. Read the following how-to paper and think about causes and effects.**

The Color of Light

Nearly 300 years ago in England, Sir Isaac sat by his study window on a rare, sunny day. The sunlight played over the prism, a triangular piece of glass, he held in his hand. The sparkling colored light danced on the walls of his study. He noticed that when the rays of the sun, called white light, passed through the prism, the colors of the rainbow could be seen.

This made him curious. Sir Isaac was always feeling curious. When an apple had fallen on his head, it made him wonder about the force pulling on the falling apple. This led him to his theory about gravity. Now he was curious about the colored light he saw emerging from the prism.

Sir Isaac knew that a current theory stated that the thickness of a prism changed the actual color of light when it passed through a prism. However, he had a different idea. He thought that a prism *separated* the colors already present in white light.

Sir Isaac decided to repeat the prism experiment. Every time he conducted it, he saw that the resulting "rainbow" light always appeared in the same order. The colors produced—red, orange, yellow, green, blue, indigo (blue violet), and violet—always maintained the same order every time he passed white light through the prism. Sir Isaac noticed that when a second prism was used, the rainbow of colors could be changed back into white light.

Unlike sound waves, light waves do not need a substance to travel through. They can travel through the emptiness of space. Ordinary sunlight, called white light, has waves of many different lengths. Each color has its own wavelength. When white light passes through a prism, each color of light bends at a specific angle. As a result, the colors leaving the prism always keep the same order. Red is the color with the longest wavelength, so it is the top band on the rainbow. Violet has the shortest wavelength, so it is the bottom band on the rainbow.

Light passing through water or raindrops in the atmosphere can create a rainbow in the sky. The drops act like little prisms bending white light and separating it into the different colors.

Sir Isaac's theory of light and color was a new one. Many scientists of his day were angry with him. They did not agree with his theory. He eventually grew tired of the argument and wrote a letter saying he was sorry he had ever put forth his idea.

Name _____ Date _____

Match the correct effect to its cause. Look back through the selection. Write the letter of the effect beside its cause.

CAUSE	EFFECT
_____ **1.** Colored light danced on Newton's study wall and	**a.** emerged from the prism in a rainbow of colors.
_____ **2.** An apple falling made Newton wonder and	**b.** the colored light blended back into white light.
_____ **3.** Newton noticed that white light going into a prism	**c.** can create a rainbow in the sky.
_____ **4.** When Newton repeated the prism experiment,	**d.** it discouraged Newton, and he wrote a letter of regret.
_____ **5.** When Newton used a second prism on the rainbow light,	**e.** led him to his theory about the force called gravity.
_____ **6.** Because red has the longest wavelength,	**f.** it emerges as the top band of color.
_____ **7.** Because violet has the shortest wavelength,	**g.** he noticed that the colors always kept the same order.
_____ **8.** Light passing through raindrops	**h.** made him curious.
_____ **9.** When other scientists argued with Newton's light theory,	**i.** it emerges as the bottom band of color.