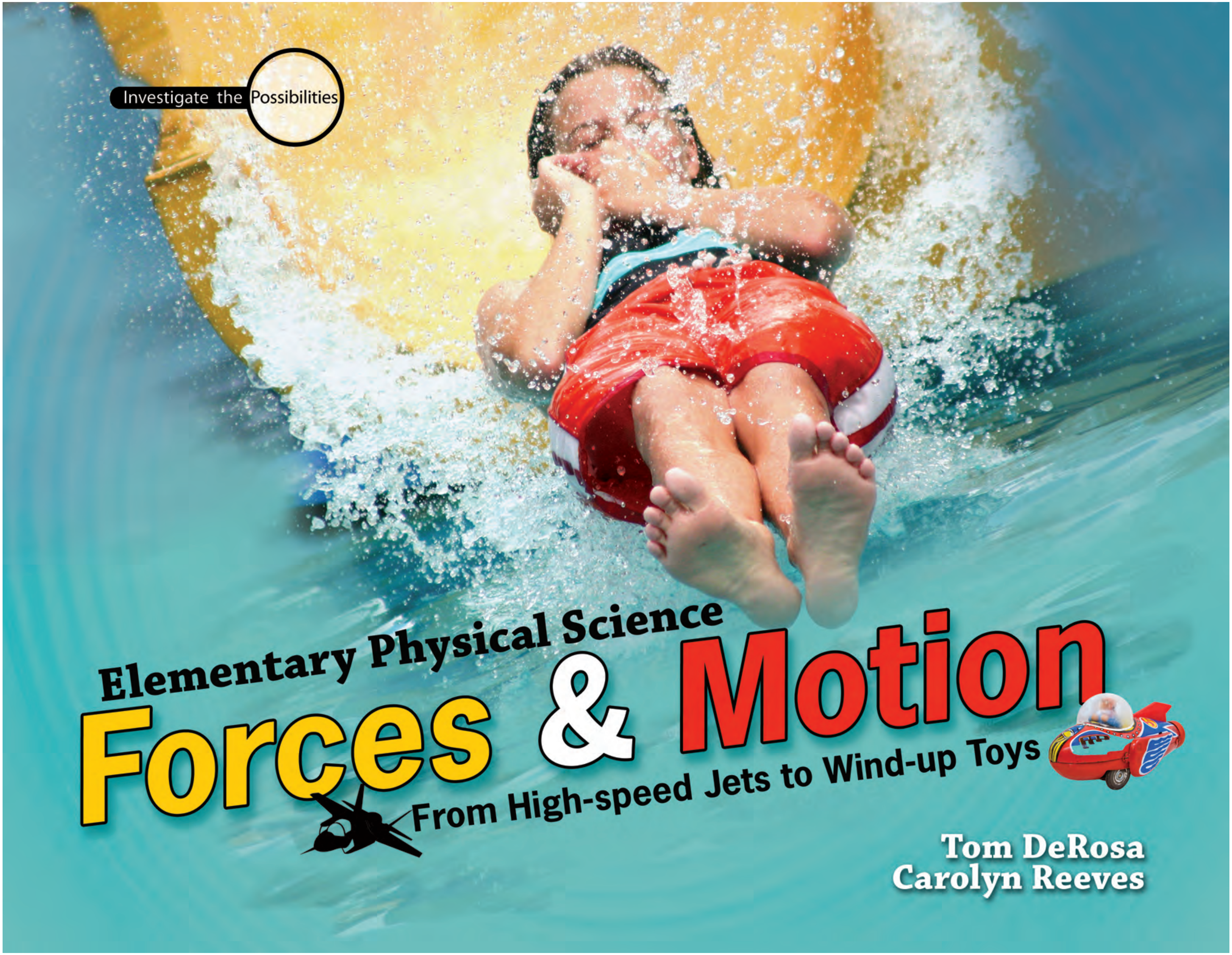
Investigate the Possibilities
Elementary Physical Science
Forces & Motion
From High-speed Jets to Wind-up Toys
Tom DeRosa
Carolyn Reeves

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DEDICATION

Dedicated to the memory of Jill Whitlock

The staff, friends, and family at the Creation Studies Institute would like to give thanks to the Lord for the time we had working with Jill Whitlock at this ministry. She began this elementary science curriculum project with dedicated commitment for her Creator and will always be remembered for her deep love for the creation message. She made many significant contributions as a dedicated researcher and writer. She went home with the Lord suddenly on December 29, 2007, and she will be missed.

Scientists:

Archimedes (287–212 BC)

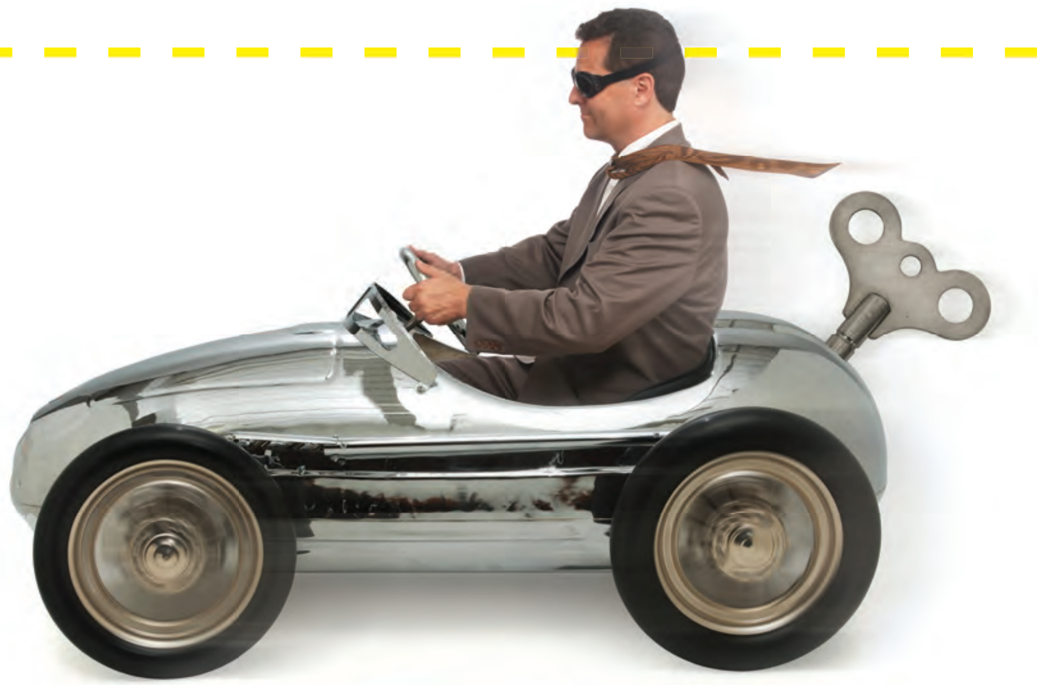
Daniel Bernoulli (1700–1782)

Galileo (1564–1642)

Isaac Newton (1642–1727)

Investigation #1

Wind-up Walking Toys
Speed, Time, and Distance

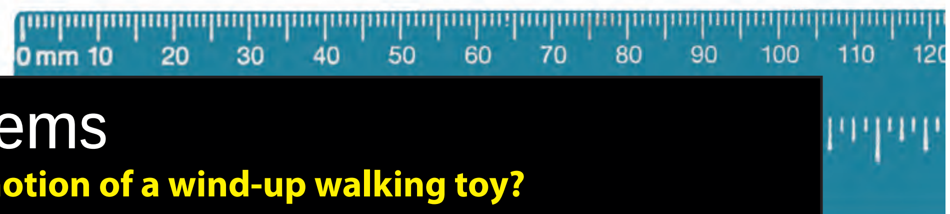


Think about This

Many people still consider "Bullet" Bob Hayes to be the world's fastest runner. In the 1964 Tokyo Olympics, he was part of a 4 X 100 relay race. He was already running when he took the baton. He completed his 100 meters of the relay in 8.6 seconds. He also ran the 100-meter dash in 10.05 seconds. In this race, he started from a still position. Four years later at the Mexico City Olympics, James Hines ran an official time in the 100-meter dash that was less than 10.0 seconds for the first time ever. His record stood for several more years, but Bullet Bob's relay race time will be a hard record to break.

These very fast runners were moving an average of about ten meters every second. Use a meter stick to mark off ten meters and make a prediction of how many meters you think you could run each second. Would you like to be able to figure out how many meters you can run in one second?

We can calculate the speed of a moving object by testing wind-up toys. How far a wind-up toy moves can be measured with a ruler. How long it takes the toy to move a certain distance can be measured with a watch. These two numbers can be used to calculate its speed.

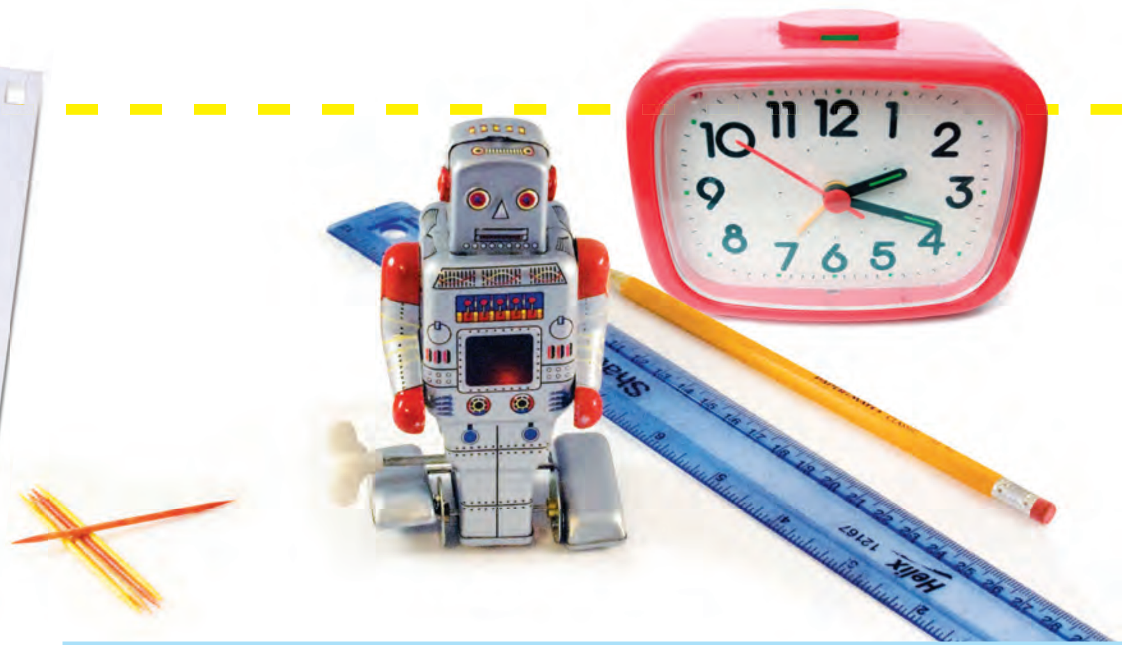


The Investigative Problems

How can we determine the speed and motion of a wind-up walking toy?
How can this be shown on a graph?

Gather These Things:

- ✓ Walking toy
- ✓ Chart
- ✓ Pencil
- ✓ Clock with second hand
- ✓ Toothpicks
- ✓ Metric ruler (with each cm divided into tenths)



Procedure & Observations

1) For these measurements, you will need a metric ruler where each centimeter is divided into tenths. Look carefully at the markings on the ruler. Notice there is a long line by each number. There are shorter lines following each number. The short lines are written as decimal numbers. Measure the line to the right by putting the zero mark of the ruler at the beginning of the line. The correct answer is found by writing the last whole number, a decimal, and the number of short marks following the number. The abbreviation "cm" is written after these numbers. Did you get 15.3 cm for your answer? Work with a partner. Each of you should draw two or three more lines. Measure each other's lines. Check each other's answers.

2) Lay the ruler out in front of you. Wind up the walking toy next to the ruler and measure how far it walks in ten seconds. Record. Calculate its average speed by dividing the total distance it walked in centimeters by ten seconds. Write your number answer followed by cm/s. This is read "centimeters per second."

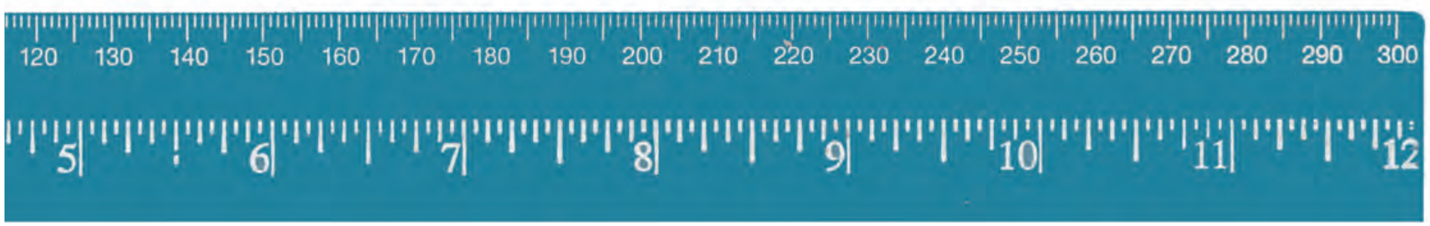
3) Measure how long it takes for the wind-up toy to walk one meter. Record. If it doesn't make it that far, record how far it walked and the time it walked. Calculate its average speed by dividing the distance it walked by the time. The speed will be in m/s (meters per second) if it walks as far as a meter. If you measure the distance in cm, your answer will be in cm/s.

4) Go back to the starting point. Wind up the toy again. This time lay down a toothpick next to the ruler every time the instructor calls out a five-second interval. Record for 30 seconds. Measure the distances between toothpicks and record in the chart below.

5) Graph the results of distance versus time. Your teacher will show you how to put this information in the graph. Does your graph make a straight line or a curved line? Try to think of a reason for this.

6) Did your walking toy start out fast and then get slower until it stopped, or did it keep walking at the same speed all the way?

7) Race your walking toy with someone else's. Which one was the fastest?



The Science Stuff

The motion of an object can be described by changes in its position, by its direction, and by its speed. Speed can be calculated by measuring the distance an object moves and the time it takes to move that distance. Divide the distance by the time to get the speed.

The distance traveled equals the object's speed multiplied by the time traveled. The same units of time must be used. For example, if a toy travels 50 cm/minute and it travels for a total of two minutes, it has traveled a total of 100 cm. The calculations would be 50 cm/min X 2 min = 100 cm. Minutes would cancel out, leaving cm as part of your answer.

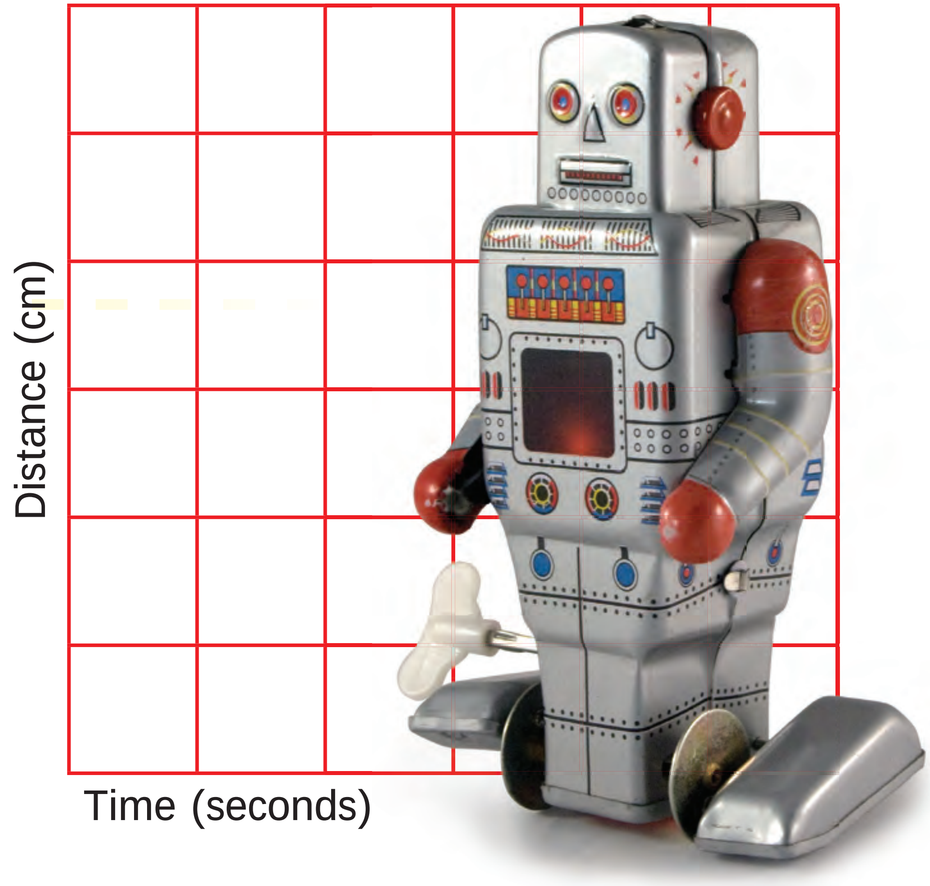
Different aspects of motion can be shown on a graph. If the speed of the walking toy stayed the same, the graph line will be straight, but if your walking toy slowed down, the graph line will be a curve. Remember, the source of energy for walking toys is a wind-up spring. A tight spring may provide more energy than a loose spring.

Scientific measurements are taken in metric units. The correct abbreviation for centimeter is cm; for meter, it is m. The correct abbreviation for centimeters per second is cm/s; for meters per second, m/s.

1 centimeter (cm) = 1/100 meter

1 meter (m) = 100 centimeters

1 kilometer (km) = 1000 meters



Dig Deeper

See if you can use the Internet or some reference books to find the runners who have run at official speeds of ten meters per second or greater. (There won't be many.)

Do additional research to find some more world records for swimming, skating, bicycling, or other sports.

Use the Internet or some reference books to find the top speeds of several animals. Did you find any that you could outrun? What is the difference in how humans run and how certain animals run?

(If you choose one of these projects, use a creative way to display your findings.)

Making Connections

Sometimes a highway patrol officer will stop a car for speeding, and the driver will insist that the car was traveling within the speed limit. Is it possible that a car's speedometer is not accurate? Mile markers along the highway and a watch can tell if your car's speedometer is accurate. To do a test, have the driver hold the car's speed at 60 miles/hour. Start timing with a watch that has a second hand as the car reaches a mile marker. Stop timing as the car reaches the next mile marker. The speedometer is accurate if the car travels one mile in 60 seconds. One mile/minute is the same as 60 miles/hour. You can also calculate the speed of your car by dividing the distance of one mile by the time it takes the car to travel from one mile marker to another.

Suppose you are traveling in a car with the cruise control set at 65 miles per hour and your driver drives for two hours without stopping. Multiply the speed by two hours to see how many miles you have traveled in two hours, as: 65 mi/hr X 2 hr = 130 miles.

What Did You Learn?

1) What two things do you need to know in order to calculate speed?

2) What is the formula for calculating speed?

3) How would a line graph of the speed of a runner look when the runner goes slower and slower? Or faster and faster? Or maintains the same speed?

4) What are three ways in which motion can be described?

5) If you are riding in a car that is traveling at 60 miles per hour and you travel for three hours, how far have you traveled?

6) Suppose an object is traveling at a supersonic speed of 800 m/s. Write this speed using all words and no symbols.

7) Calculate the speed of an animal that ran 50 meters in 10 seconds. Write the number answer with the correct unit symbols.

8) What is the source of energy for the walking toys you used for this activity?