USING PHYSICAL SCIENCE

GADGETS & GIZMOS

GRADES 3–5

PHENOMENON-BASED LEARNING

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EDUCATION

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ELECTRIC CIRCUITS 51

Chapter 6 is organized a little differently from the other chapters because all the explorations involve different types of electrical circuits made from the same kit.

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1 Let's Explore!

SAFETY NOTE

Toy cars on the floor can be a serious trip or fall hazard. Use caution when working with equipment during this activity.

FIGURE 1.1: Constant Velocity Car

SPEED RACER

Here you will learn about constant speed, and you will measure some speeds with simple tools.

1. What toy do you have? How does it work?
2. Turn on the Constant Velocity Car (Figure 1.1) and then describe its speed. Is it faster or slower than a snail? a turtle? a rabbit? a horse? you?
3. *Speed* tells you how fast the toy or any object moves. Actually, it tells you how many meters the toy moves in one second—or how many miles a car travels in one hour. In your group, discuss what two things you need to measure if you want to find out the speed of the toy car.
4. Tell your teacher what you think about this. If your teacher believes you understand, then get the things that you need to measure the speed of the toy car.
5. Measure what you need to in order to find out the speed of the car. Repeat the measurements at least six times to make sure you did not make a mistake. Each measurement might be a little different. It is very important to write down your measurements. You can write down your measurements in a table like Table 1.1.
6. Compare the speed you calculated with the fastest speeds of some animals.

TABLE 1.1

TABLE FOR RECORDING MEASURED SPEEDS

Trial #	Distance in meters (m)	Time in seconds (s)	Divide the distance by the time. Write down your answer in meters/second (m/s).
1			
2			
3			
4			
5			
6			

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What's Going On? 1

SPEED RACER

Speed tells you how fast an object is moving. To figure out the object's speed, you need to know two things: the distance traveled and the time it took. The distance can be measured in units such as inches, feet, meters, or kilometers. The time can be measured in units such as seconds or hours. You will need to use a stopwatch to measure how long the object takes to move. Once you know the distance and the time, you can figure out the speed. To get the speed, divide the distance by the time.

For example, if the distance is 10 meters and the time is two seconds you would divide:

10 meters ÷ 2 seconds = 5 meters/second

Your answer might not be a whole number. For example, if the distance is one meter and the time is 2.5 seconds, you would divide:

1 meter ÷ 2.5 seconds = 0.4 meters/second

FIGURE 1.4: Constant Velocity Car

Notice how when you divide meters by seconds, you get meters/second, which is pronounced, "meters per second." Meters/second is a unit of speed. Other units of speed are kilometers/hour or miles/hour. These are pronounced "kilometers per hour" and "miles per hour." You might have seen miles/hour written as MPH. On some roads, the speed limit is 55 MPH.

Table 1.2 shows speeds of different things and how long it takes them to move 40 yards on average.

The Constant Velocity Car (Figure 1.4) moves at a constant speed, which means it moves the same distance in each second.

TABLE 1.2

SPEEDS OF DIFFERENT THINGS AND THE TIME IT TAKES THEM TO MOVE 40 YARDS

Things timed	40 yard time in seconds (s)	m/s	MPH	km/h
Fast baseball pitch	0.8	44.7	100	161
Running back	4.5	8.0	18	29
Speed limit	1.3	29	65	105
Cougar	1.63	22.4	50	80.5
Rabbit	2.3	15.65	35	56.3
Turtle	73	0.5	1.1	1.8
Snail	2,727	0.013	0.03	0.048

Web Resources

Learn to graph position, velocity, and acceleration. Move a little man around with the mouse and plot his motion. Setting the position, velocity, or acceleration allows the simulation to move the man.
http://phet.colorado.edu/en/simulation/moving-man

Simulations to help students understand relationships among distance, speed, and time.
Information: *www.learnnc.org/lp/external/4413*
Simulation: *www.nctm.org/standards/content.aspx?id=25037*

Examples of the speed formula, a speed formula worksheet, and a study guide.
www.brighthubeducation.com/lesson-plans-grades-3-5/35416-teaching-the-speed-formula-includes-worksheet-and-study-guide/

A worksheet to help students determine the correct multiplication and division equations and calculate answers about distance and speed.
www.greatschools.org/worksheets-activities/5919-calculating-speed.gs

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Relevant Standards

Note: The Next Generation Science Standards *can be viewed online at* www.nextgenscience.org/next-generation-science-standards.

PERFORMANCE EXPECTATIONS

K-PS2-2

Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

4-PS3-1

Use evidence to construct an explanation relating the speed of an object to the energy of that object.

DISCIPLINARY CORE IDEAS

PS2.A: Forces and Motion

- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.
- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.

PS3.C: Relationship Between Energy and Forces

- A bigger push or pull makes things speed up or slow down more quickly. (secondary to K-PS2-1)

PS2.A: Forces and Motion

- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1)