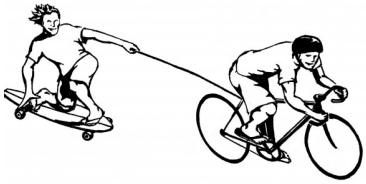
Name _____ Date _____ Period _____



FORCED TO ACCELERATE

PURPOSE: How is the acceleration of a skateboard related to the force that is pulling it?

MATERIALS:

- Skateboard
- Meter stick
- Stopwatch
- String
- Masking tape
- Several bricks or other large mass(es)
- Spring scale, 5-N

PROCEDURE

1. Attach a loop of string to a skateboard. Place the bricks on the skateboard.
2. Using masking tape, mark off a one-meter distance on a level floor. Label one end "Start" and the other "Finish."
3. Attach a spring scale to the loop of string. Pull it so that you maintain a force of 2.0 N. Be sure to pull with the scale straight out in front. Practice applying a steady force to the skateboard as it moves.
4. Copy the data table into your notebook.
5. Find the smallest force needed to pull the skateboard at a slow, constant speed. Do not accelerate the skateboard. Record this force on the first line of the table.
6. Add 0.5 N to the force in Step 5. This will be enough to accelerate the skateboard. Record this force on the second line of the table.
7. Have one of your partners hold the front edge of the skateboard at the starting line. Then pull on the spring scale with the force you found in Step 6.
8. When your partner says "Go" and releases the skateboard, maintain a constant force until the skateboard reaches the finish line. A third partner should time how long it takes the skateboard to go from start to finish. Record the time in the column labeled Trial 1.
9. Repeat Steps 7 and 8 twice more. Record your results in the columns labeled Trial 2 and Trial 3.

10. Repeat Steps 7, 8, and 9 using a force 1.0 N greater than the force you found in Step 5.
11. Repeat Steps 7, 8, and 9 twice more. Use forces that are 1.5 N and 2.0 N greater than the force you found in Step 5.

OBSERVATIONS:

DATA TABLE

Force (N)	Trial 1 Time (s)	Trial 2 Time (s)	Trial 3 Time (s)	Average Time (s)	Average Speed (m/s)	Final Speed (m/s)	Acceler-ation (m/s^2)

1. For each force, find the average of the three times that you measured. Record the average in your data table.
2. Find the average speed of the skateboard for each force. Use this formula.:
   Average speed = 1 m ÷ Average time
   Record this value for each force.
3. To obtain the final speed of the skateboard, multiply each average speed by 2. Record the results in your data table.
4. To obtain the acceleration, divide each final speed you found by average time. Record the acceleration in your data table.
5. Make a line graph in the grid provided on the next page. Show the acceleration on the *y*-axis and the force on the *x*-axis. The *y*-axis scale should go from 0 m/s^2 to about 1 m/s^2. The *x*-axis should go from 0.0 N to 3.0 N. If your data points seem to form a straight line, draw a line through them.

Remember to Title the graph and label the x- and y-axis'.

ANALYSIS/CONCLUSIONS:

1. Your first data point is the force required for an acceleration of zero. How do you know the force for an acceleration of zero?

2. According to your graph, how is the acceleration of the skateboard related to the pulling force?

CRITICAL THINKING AND APPLICATION:

1. Write a paragraph in which you identify the manipulated variable and the responding variable in this experiment. Describe other variables that might have affected the outcome of this experiment. (See the Skills Handbook to read about experimental variables.)

2. Design an experiment to test how the acceleration of the loaded skateboard depends on its mass. Think about how you would vary the mass of the skateboard. What quantity would you need to measure that you did not measure in this experiment? Do you have the equipment to make that measurement? If not, what other equipment would you need? *Obtain your teacher's permission before carrying out your investigation.*