Beetle Races!
Measuring Distance and Time and Calculating Rate

PURPOSE

In this activity, you will measure the distance traveled by your selected mealworm beetle, *Tenebrio molitor,* during three 45-second races. You will collect data at 5-second intervals during each race. You will analyze your data to determine the 5-second intervals during which your beetle was the fastest and the slowest, as well as determine the average speed of your beetle for each race. You will also generate graphs to better communicate your results.

MATERIALS

Each lab group will need the following:

beetle, Tenebrio molitor
marker, Vis-à-vis®
paper towels
paper, graph
Petri dish
stopwatch
1 roll string
2 strips of index cards, 3 in. × 5 in.

PROCEDURE

1. Working with your partner, select what you believe to be the fastest adult *Tenebrio molitor* beetle from the mealworm container and use the two strips of index card to place it into a Petri dish. Use the Petri dish to take your beetle contestant back to your desk or table. Give your beetle a name. Do not torture or harm your beetle, otherwise you will receive no credit for today's activity.

2. Mark a small "X" with the overhead pen in the middle of your desk or table. This will serve as the starting point for the race.

3. Use the two strips of index card to carefully transfer your beetle from your Petri dish onto the "X" you have drawn on your desk or table. Make sure your beetle is upright.

4. One student will start the stopwatch as soon as the beetle begins to move off the "X." At the same time, another student will trace the path the beetle travels with the overhead pen. The first student will call time every 5 seconds as the second student makes a small mark on the line to indicate the position of the beetle when time was called. Continue to trace the path of the beetle for the entire 45 seconds of the "race." Your line may be squiggly or it may be straight.

5. Motivate your beetle by chanting its name and cheering it on without touching it. You may very gently nudge the beetle with a small piece of paper to initiate its progress, but do not push it in any way that may affect its rate of movement. The same beetle must be used during all three trials.

PROCEDURE (CONTINUED)

6. When your beetle has traveled a total of 45 seconds, stop collecting data and make your final mark on the path. Gently place the beetle back into the Petri dish using the two strips of index card, and allow it to rest before the next race.

7. Use a ruler to construct a data table showing how far the beetle cumulatively traveled during each 5-second interval for up to 45 seconds. You will collect three sets of distance data, one for each of the three races your beetle runs.

8. Use your piece of string to trace the beetle path by laying it on top of the line you have drawn on the desk or table. Measure the total distance traveled by the beetle at the end of each 5-second interval. Be sure to measure the total distance for each interval by measuring from the original starting point to each mark. The distance measurements should increase with each interval.

   Record your distance measurements in centimeters, making sure you estimate between the marks on your ruler or meter stick. It is critical that your distance measurements are as accurate as possible to the nearest 0.01 cm. For example, the first measurement might be recorded as 7.35 cm (if this was how far the beetle traveled) and not 7.4 cm, nor 7 cm.

9. Use a damp paper towel or sponge to wipe off the overhead pen marks from your desk or lab table and repeat the procedure twice more for a total of three races.

10. Construct an appropriately titled graph showing the progress of your *T. molitor* beetle during the three races. Time in seconds is graphed on the *x*-axis, and distance in centimeters is graphed on the *y*-axis.

11. The three trials will be graphed as three separate data sets on your graph paper. Make each set a different color or a different symbol so you can tell them apart. Make a key defining the color or symbol for each data set, Trial #1, Trial #2, and Trial #3.

12. Do not connect the data points. Draw the manual fit straight line through the points, keeping an equal number of points above and below the line you are drawing. This line represents the average rate of speed traveled for the entire 45 seconds of the race. The line will generally slope upward over time.

13. The “faster” beetles will be put back into the gene pool and allowed to breed. The “slower” ones become a tasty meal for a lizard. This is known as *artificial selection.* This practice is done with race horses all the time. The “fast” genes will be selected artificially rather than letting that animal choose its own mate from the total population. Maybe after a thousand generations, we will have the fastest beetles in the world!

DATA

Using a PEN and RULER draw a data table as described in the procedure. The table should contain space for at least 10 data points for each Trial.

CONCLUSION QUESTIONS

1. Examine your graph. Which trial was the fastest? Justify your answer.

2. Examine your graph. Which trial was the slowest? Justify your answer.

3. What evidence from your graph allowed you to observe and then recognize the fastest trial?

4. Examine the data in your data table and calculate the average speed for each one of your three trials. The rate represents the total distance traveled divided by the total time measured. Pay particular attention to the units of your answer. The equation for this rate is

$$\text{rate} = \text{speed} = \frac{\text{distance (cm)}}{\text{time (s)}}$$

CONCLUSION QUESTIONS (CONTINUED)

5. Examine the data in your data table and calculate the fastest rate that your beetle traveled during any 5-second interval for any of the three trials. (Hint: Focus on the farthest distance that the beetle traveled during a 5-second interval.) Pay particular attention to the units of your answer.

6. Examine the data in your data table and calculate the slowest rate that your beetle traveled during any 5-second interval for any of the three trials. (Hint: Focus on the shortest distance that the beetle traveled during a 5-second interval.) Pay particular attention to the units of your answer.