Quick Lab

Comparing Distance and Displacement

Procedure

1. Draw a dot at the intersection of two lines near the bottom edge of a sheet of graph paper. Label the dot "Start."
2. Draw a second, similar dot near the top of the paper. Label this dot "End."
3. Draw a path from the Start dot to the End dot. Choose any path that stays on the grid lines.
4. Use a ruler to determine the distance of your path.
5. Use a ruler to determine the displacement from start to end.

Analyze and Conclude

1. **Observing** Which is shorter, the distance or the displacement?
2. **Evaluating and Revising** How could you have made the distance shorter?
3. **Inferring** If you keep the Start and End points the same, is it possible to make the displacement shorter? Explain your answer.

Measuring Displacements

To describe an object's position relative to a given point, you need to know how far away and in what direction the object is from that point. Displacement provides this information. **Distance is the length of the path between two points. Displacement is the direction from the starting point and the length of a straight line from the starting point to the ending point.**

Displacements are sometimes used when giving directions. Telling someone to "Walk 5 blocks" does not ensure they'll end up in the right place. However, saying "Walk 5 blocks north from the bus stop" will get the person to the right place. Accurate directions give the direction from a starting point as well as the distance.

Think about the motion of a roller coaster car. If you measure the path along which the car has traveled, you are describing distance. The direction from the starting point to the car and the length of the straight line from the starting point to the car describe displacement. After completing one trip around the track, the roller coaster car's displacement is zero.

Combining Displacements

Displacement is an example of a vector. A **vector** is a quantity that has magnitude and direction. The magnitude can be size, length, or amount. Arrows on a graph or map are used to represent vectors. The length of the arrow shows the magnitude of the vector. Vector addition is the combining of vector magnitudes and directions. **Add displacements using vector addition.**

Displacement Along a Straight Line When two displacements, represented by two vectors, have the same direction, you can add their magnitudes. In Figure 3A, the magnitudes of the car's displacements are 4 kilometers and 2 kilometers. The total magnitude of the displacement is 6 kilometers. If two displacements are in opposite directions, the magnitudes subtract from each other, as shown in Figure 3B. Because the car's displacements (4 kilometers and 2 kilometers) are in opposite directions, the magnitude of the total displacement is 2 kilometers.

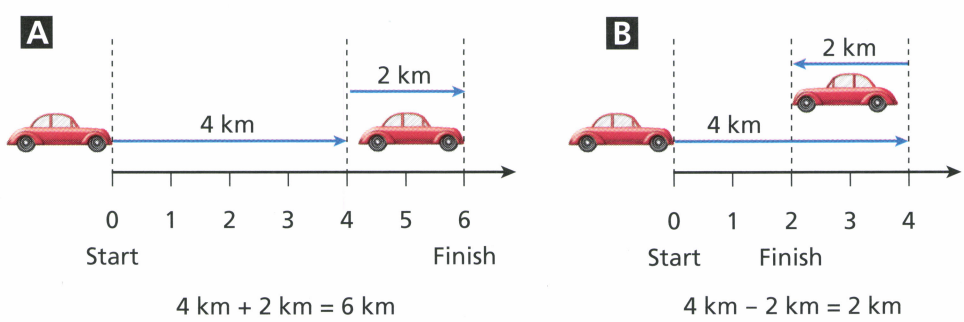

Figure 3 When motion is in a straight line, vectors add and subtract easily. **A** Add the magnitudes of two displacement vectors that have the same direction. **B** Two displacement vectors with opposite directions are subtracted from each other.