Distance Vs. Displacement

Problem: How will the distance traveled from a reference point affect its displacement distance?

Background: Motion is a change in position. So an item moves if it changes position. To be able to say that something changed position, the initial position must be marked. This initial position is a reference point. Movement occurs when an item starts at the reference point and changes to a new position. Everyday changes in position are measured with distance. **Distance** is only a measurement of length. An item that moves has both distance and direction. Scientists measure changes in position with **displacement** (displacement is the overall distance with direction). Some objects can have a distance of 50 meters but a displacement of 0 meters. This lab will show you

Materials: you will need a measuring tape, sticky notes or something to mark start/end, your steps, stopping/turning points.

Follow the instructions below to fill out the data tables as you walk three different paths and measure the distance and displacements.

Procedure (Data will be recorded in Procedure):

Path #1

1. Place a piece of tape/post it or any type of "marker" where you will begin your walk. This tape marks the ***"starting point".***

2. Walk 10 meters forward and stop (forward is whatever direction you choose!). **This is distance #1 (place a post it/marker).** Using the number of steps you took (try to be consistent) measure distance #1. Write that distance in the table below. (Don't forget your units- in this case, just use steps!)

3. Now turn around (180°) and walk 5 meters and stop (place a post it/marker). **This is distance #2.** in meters . Write that distance in the table below.

4. Now turn around again (180°) and walk 15 meters and stop to place another post it. **This is distance #3.** Write that distance in the table below.

5. Finally, measure how far you are from the *starting point*. **This is your measured displacement.** Write that displacement in the table below.

6. Sketch a diagram/sketch of the walk you completed for Activity #1

Measured Distances (meters)		Measured Displacement (meters)	
Distance #1		Total Displacement for Path #1	
Distance #2			
Distance #3			
Total Distance for Path #1			

Path #2

7. Find your piece of tape again, and walk 5 meters forward and measure how far you walked. This is **distance #1**. Record below. **(leave markers each time you stopped)**
8. Turn 90° (right angle) left, walk 10meters (2m if inside) and measure how far you walked. This is **distance #2.** Record below.
9. Turn 90° left, walk 5 meters (5m if inside) and measure how far you walked. This is **distance #3**. Record below.
10. Turn 90° left, walk 15 meters (3m if inside) and measure how far you walked. This is **distance #4.** Record below.
11. Using your markers from the starting point and stopping point, measure how far you are from the *starting point*. This is your **measured displacement**. Record below.
12. Sketch a diagram/sketch of the walk you completed for Activity #1

Measured Distances (meters)		Measured Displacement (meters)	
Distance #1		Total Displacement for Path #2	
Distance #2			
Distance #3			
Distance #4			
Total Distance for Path #2			

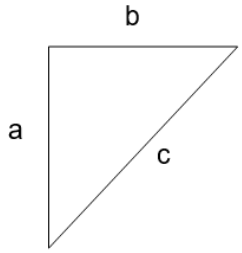
Path #3

13. Find your piece of tape again, and walk 6 meters forward. This is **distance #1.** Record below. Don't forget to place your markers

14. Turn 90° right and walk 8 meters (2m if inside). This is **distance #2.** Record below.

15. Measure how far you are from the *starting point.* This is **measured displacement.** Record below.

16. Find your **calculated displacement**. To find the calculated displacement, we're going to do some simple trigonometry (by using the Pythagorean Theorem).
    Here's a way to figure out your **calculated displacement**. You can use Pythagoras Theorem – $a^2 + b^2 = c^2$



How to solve mathematically for displacement:

a. Square a = _____ square b =_____ now add these two numbers together = **_____ (use this in b below)**

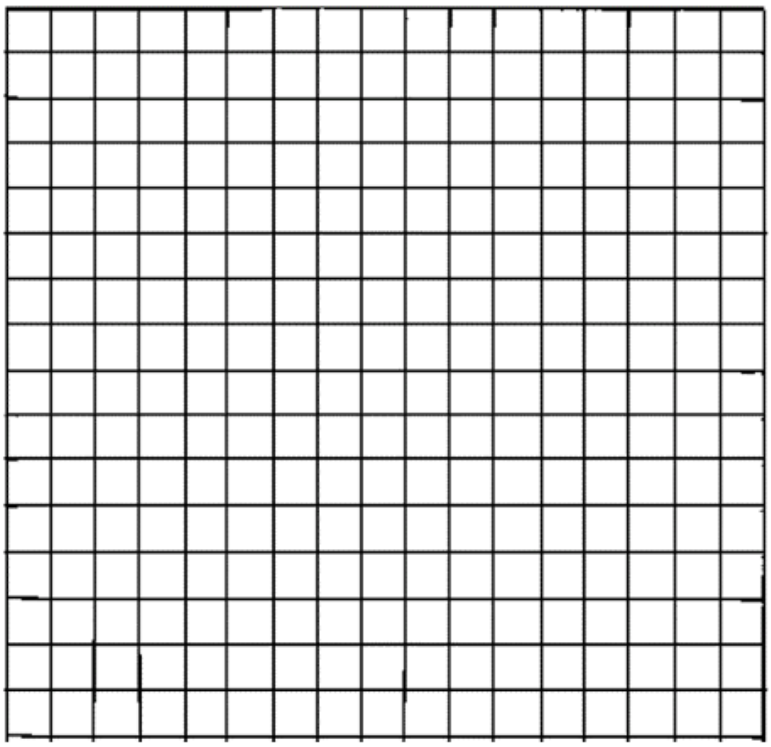
b. Now square root the sum of the squares you measured in question a _____ (*don't forget units, both magnitude and direction*) (*your measured displacement*).

17. Sketch a diagram of the walk you completed for Activity #3 and indicate displacement with a vector arrow. Show all your measured distances and displacements on the diagram.

Measured Distances (meters)		**Calculated Displacement (meters)**	
Distance #1		Total Displacement for Path #3	
Distance #2			
Total Distance for Path #3			

Analysis:

On the grid below, map out and diagram **path #3** and indicate displacement with an **arrow**. Create a key on the side to show me your scale. (example 1 meter = 1 square)



1. In each path you took, did the order of the walker's steps or direction affect the distance or displacement? Explain

2. Did you notice a trend in the total distance of each trial compared to the displacement of each trial? Explain.

3. Explain the difference between distance and displacement in your OWN words.

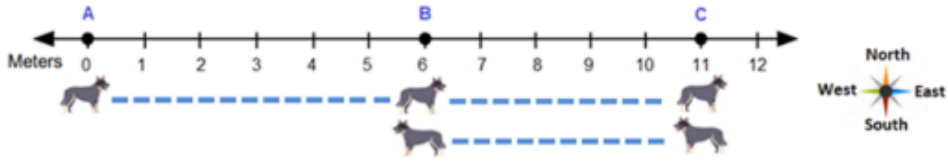
4. What is the difference between scalar and vector (you can look up on https://www.physicsclassroom.com/class/1DKin/Lesson-1/Scalars-and-Vectors ?)

5. If you found a treasure map, would you want it to have **scalar** or **vector** directions? Circle one and explain why.

6. Sam's mom says: "We're about to eat dinner! Don't go more than a few blocks from home!" Is Sam's mom more worried about Sam's **distance** or his **displacement**? explain why you picked it.

7. Explain why displacement is a vector quantity.

8. **Q.2.** A dog moves from point **A** to point **B** to point **C**, then back to point **B** along the line shown in the figure below.



What is the dog's **distance** and **displacement**?

Distance=

Displacement =

9. **Q.3.** A truck moves from **A** to **D** along the path as shown below.

Distance=

Displacement =