**Introduction**

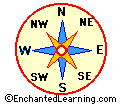
**Purpose**

To create a series of directions that lead to a specific target, follow directions to locate that target, develop a standard notation for writing direction symbols and generate a scale map.

**Discussion**

A vector is comprised of (1) a number (magnitude) WITH (2) a direction. A vector ALWAYS has a magnitude (*with units*) and a direction that defines it. A “scalar” quantity only includes magnitude (*with units*). Vectors are indicated by lines with arrows. Vectors are often drawn to scale and the magnitude can be measured just like a scale on a map.

Cardinal Directions Intercardinal Directions



**N**

**E**

**S**

**W**

NNE

SNE

NSE

SSE

NNW

SNW

NSW

SSW

* Using the two vectors (*one running due east and the other* 45° *SE*), we can graphically add the two vectors “head to tail” to find the resultant.

Resultant

* + When adding (or subtracting) vectors, the order of addition (or subtraction) does not matter. In the example above, *the dashed line represents the sum of the two vectors*. Notice, one may add them in more than one way.

R

Notice, one may add vectors in more than one way and still get the same **resultant** [R].

R

R

**Hypothesis**

If vectors are obtained for a series of measurements, then one can find the “target” object in various ways.

**Materials** 15 Index cards per pair Meter Stick Protractor Compass

**Procedures (Plotting)**

1. Obtain 15 index cards or pieces of paper. On the BACK of each card, number them from 1 to 15 consecutively.

2. Chose an object in the building or outdoors that is non-movable, large and obvious so anyone could find it by following the directions you will provide them.

3. The starting point of this exercise is just INSIDE the present room by the door.

4. Use the meter stick to determine your pace length in order to use meters for the distances. Convert your pace to meters before recording the values for each distance.

5. Break up the course to your target into 15 different segments, writing EACH separate segment as a distance (*in meters*) and a direction (*N, S, E or W*) on an index card. Each index card must contain a complete description of that segment (*magnitude and direction*).

[**KEEP your distances longer than 2 meters, but not longer than 20 meters, using an even number of meters. *You can use more than one index card when heading in a specific direction.***]

6 meters SOUTH

10 meters West

6 meters West

4 meters North

12 meters North

2 meters North

6. Use a compass to determine N, S, E, W (use a phone app if necessary).

7. On the BACK of the last index card, write the target object.

**Calculations and Data**

8. Return to the room and get out a piece of blank paper. Scrap paper is fine.

9. Use a metric ruler and create a SCALE for making a map. 1 cm = 2 meters might work.

10. Make a map of your course from the distances and directions on the index cards. Each distance and direction will be represented by a straight-line arrow drawn to scale (This is called a “vector”).

11. Lay out the cards in front of on the table in order and according to direction. This will show you the shape of your map so you can fit it on your paper.

12. Draw the first arrow so that its “tail” is at the starting point and the “head” is pointing in the direction your walked.

MAP 1 cm = 2 m

N

E

W

S

Start

End

13. For all right angle turns, use a protractor to measure 90 degrees.

14. Draw the second arrow so that its “tail” starts at the “head” of the first arrow. The length of the arrow represents the distance (to scale) on the index card.

6 m

W

15. Continue to draw the arrows for each index card.

16. Include a legend or key that gives the cardinal directions and defines the scale of the map.

**Conclusions and Questions**

1. Place your index cards in order (*from #1 to 15*) and see if another person can find the target object. How close did they come? Explain any discrepancies.

2. Imagine having done this exercise in an open field with no walls or impedances. Would it be possible to shuffle the index cards (*change their order*) and still find the target object (*assuming you use the same starting point*)? If possible, find a large field (e.g. football field) and try this exercise. Explain.

3. This lab helped you to learn about “VECTORS.” Give at least three important aspects of vectors.

ANSWERS

**Conclusions and Questions**

1. Place your index cards in order (*from #1 to 15*) and see if another person can find the target object. How close did you come? Explain any discrepancies.

*Answers will vary depending on how accurate distances and directions were given.*

2. Imagine having done this exercise in an open field with no walls or impedances. Would it be possible to shuffle the index cards (*change their order*) and still find the target object (*assuming you use the same starting point*)? Explain.

*You will end up at the same point no matter what order the cards are in as long as there are no walls and the directions and distances are accurate.*

start

1

2

3

4

start

1

2

3

4

*Change the order to 3,2,1,4 Ends at “start”*

If you place the new vector diagram at the same starting point, it will end up at the same place.

Here’s another example:

The vectors ended at the same point

3. This lab helped you to learn about “VECTORS.” Give at least three important aspects of vectors.

*Magnitude & Direction*

*Arrows are aligned “head to tail” or “tail to head” (when adding)*

*Distance is scalar (adding all parts), displacement is vector (net addition)*