Vector Treasure Hunt

Purpose: To see what affect the order in which vectors are added affects the outcome; to gain skill in visualizing and manipulating vector quantities.

Equipment and Supplies (per group of 2 students):
- 9-12 popsicle sticks of 3 lengths (short, medium, long) that are labeled with compass directions (N, S, E or W) or various angles (ex.: 45° N of W).
- brown paper bag
- masking tape

Discussion:
As part of the settlement of your grandmother’s estate you receive an old trunk and its contents, among which you find a letter from your grandmother. In it your grandmother thanks you for being such a wonderful grandchild and talks at length about the good times she has shared with you. At the end she reminds you that she never really trusted banks, so much of the money she saved before going to the retirement home she stashed in a weatherproof strong box and buried on the farm. She tells you how she carefully recorded the location of the strong box, starting from an obvious location in the back field (the Old Oak Tree), pacing out distances in various directions and recording them. She then transferred these measurements to wooden sticks, so they would last a long time, and shuffled them, just in case someone who was not in the family got hold of them. You now have these sticks in your possession. Unfortunately, a letter she mentions, giving the order in which you are to follow the directions on the sticks, is nowhere to be found! Is the treasure lost for good?

In this activity you will follow several different sets of directions to the treasure. A brown bag contains the popsicle sticks of different lengths and different directions. To begin, place two lengths of masking tape about 5 cm long near the middle of your table so that they form a “+”. Where they cross is your starting point, the Old Oak Tree. See if it is possible to determine the location of the treasure from your vector directions.

Procedure:
Have your partner reach into the bag and give you a stick at random. Place the stick with the tail of the arrow on your starting point and turn it until it points in the direction specified on the stick. Have your partner give you another stick. Add this to the first one by placing its tail at the head of the first stick and pointing in the specified direction. Repeat this until you have used all the popsicle sticks. Mark your ending point with a piece of masking tape. Then, measure the distance and the direction from your starting point to the end (the treasure!). The directed distance from the Old Oak Tree to the treasure is called the displacement.

1st Displacement = (Answers vary)
Pick up all the sticks and return them to the bag. Shake them up, and this time you pull out one stick at a time and let your partner place them in order as before. Again, measure the displacement.

2nd Displacement = ___(Answers vary)_______

Analysis & Discussion:

1. How do your two displacements compare? They are very nearly the same.

2. How does the order of the sticks affect the displacement? It doesn’t really matter in what order you add the sticks, you still end up in about the same spot.

3. Can you find grandma’s treasure? Explain. Yes! It doesn’t matter in which order we carry out grandma’s instructions, we will always end up in the same place. Some combinations of her instructions might require that we do things like walk through the wall of a building, so it might take some trial and error. And you might need to dig around a little to account for measurement error.

Conclusion:

The order in which vector displacements are added does not affect the net (or total) displacement.