

Discovery Lab

Vector Treasure Hunt

OBJECTIVES

Students will

- create a series of directions to lead to a specific object.
- follow directions to locate a specific object.
- develop standard notation for writing direction symbols.
- generate a scale map.

Planning

Recommended time

1 lab period

For a 2-period lab, have students perform the first section one day and the rest of the lab the next.

Materials

[for each lab group]

- ✓ meterstick or trundle wheel
- ✓ 16 index cards

Materials Preparation

Students may use metersticks or trundle wheels to measure the distances. A trundle wheel has a circumference of 1 m and can be used to measure distances while walking.

The most important preparation is to define the boundaries of the area students may use. Check with your administration for specific issues relating to student movement around campus. If outside, keep paths away from traffic flow, school shop areas, compressed gas storage areas, and utility entry points. If inside, keep paths away from storage areas for hazardous materials such as chemicals or gas, prep rooms, shop areas, and custodial or utility closets.

Select a starting point and define north. You may use a compass to find north or simply choose a convenient direction.

Classroom Organization

- Students may perform this lab alone or in groups of two or more students.
- Student groups will be switching cards. You may have an even number of groups and do a direct swap or simply make sure each group is given another group's cards in the second part.
- Encourage students to think of the lab as a treasure hunt.

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- **Safety warnings:** The safety issues in this lab depend primarily on where students will be working. Make sure students stay within the specified boundaries, and do not allow any disruptive behavior.

Checkpoints

Step 2: If students are counting paces as a measurement, encourage them to take turns pacing out the distance. This will help remind them to convert paces to meters.

Step 3: Some students will be tempted to use degrees to describe direction or to choose directions between specified directions. Unless you wish to modify the lab to include these options, this should be discouraged.

Step 4: Encourage students to be creative in describing the path. Students will develop an understanding of vectors and two-dimensional motion by using a wide range of directions to describe straight-line motion.

HOLT PHYSICS *Laboratory Experiments Teacher's Edition*

Step 6: Before handing a pack of cards to a group, shuffle them dramatically. Some students will realize that this is not a problem, but some will be convinced that they will not be able to find the object if the directions are out of order.

Step 7: Some students will add all the distances in each direction and find the object by following the resultant. Others will simply begin following the cards one at a time. Students may need help dealing with obstacles such as walls.

Step 11: If possible, students should work on graph paper or a computer to make the map.

Answers To:

Analysis

- A.** Answers will vary, based on the object selected and the method used to describe its location.
- B.** Answers will vary, but most will be longer. Students may realize that the straight-line path can be found by adding distances or by drawing a map and connecting the points.
- C.** Answers will vary.
- D.** Answers will vary. Students should realize that using standard notation will allow others to find the object.
- E.** Answers will vary. Some students may believe that the directions must be followed in a specific order. Other students may realize that the order doesn't matter.
- F.** Students should realize that it does not matter what order the directions are given in.
- G.** Answers will vary. Students should realize that the cards identify the same object no matter what order they are in, so they could never be sure they were in original order.
- H.** Answers will vary.
- I.** Answers will vary. Some students may have noticed that they could simply add the distances in each direction.
- J.** Answers will vary.
- K.** Answers will vary. Differences should be explained by encountering obstacles such as walls or by following a more direct path than described by the cards.
- L.** Students should realize that shuffling the cards had no affect on the positions of the starting point and the object and that the path described between them was probably not the same as the original description.
- M.** Answers will vary. Students may realize that they could simply add the distances in each direction and that this would work for any set of directions.

Two-Dimensional Motion and Vectors

HOLT MCDUGAL PHYSICS

Discovery Lab

Vector Treasure Hunt

SAFETY

- Review the lab safety guidelines. Always follow correct procedures in the lab.

OBJECTIVES

- Create a series of directions that lead to a specific object.
- Follow directions to locate a specific object.
- Develop a standard notation for writing direction symbols.
- Generate a scale map.

MATERIALS

- ✓ meterstick or trundle wheel
- ✓ index cards

Giving directions

Procedure

1. In this lab, you will select a large, fixed object at your school and use standard physics notation to direct other students to the object. Your teacher will define the starting point and the physical boundaries for this activity. Select an object within the boundaries; the object you choose should be large and obvious, and it should be fixed in place so that other students will be able to find it by following your directions.



2. Plot out a course from the starting point to the chosen object. Remember to work quietly and to avoid disrupting classes and school traffic. Use a meterstick or trundle wheel to measure the distances along the course. Alternatively, you may measure your pace in meters and use your pace to count out the distance for each part of the course. Convert your pace to meters before recording the values for each distance.

3. You will break up the course into 15 different segments, and you will write each separate segment as a distance and a direction on an index card. Each card must contain a complete description of that segment, including the magnitude of the distance in meters and the direction. The direction must be specified using only these terms: north, south, east, west, up, and down. Your teacher will tell you where north is located for the purposes of this lab.
4. Keep in mind that the cards may be used to describe the most direct path from the starting point to the object, broken up into 15 segments, or they may describe a complicated path with many changes of direction.
5. When you have completed 15 cards that give an accurate description of a path between the starting point and the chosen object, write your name on an index card, and place the card on top of the 15 cards. On a separate piece of paper,

write your name and a description of the object you chose, including a description of its location. Give this paper and your deck of direction cards to your teacher. Your teacher will keep the paper with the name of the object until the end of the lab.

Analysis

- A.** Do your cards describe the straight-line path to the object divided into 15 parts, or do they describe a winding path to the object?
- B.** Is the path described by your cards the same length or longer than the straight-line path to the object? Can your cards be used to determine the straight-line path? Explain.
- C.** What was the most difficult part of plotting the path to the object?
- D.** Are you confident that another group will be able to find the object using your direction cards? Explain why or why not.
- E.** Would another group be able to find the object using your direction cards if your cards were placed out of order? Explain your answer.

Following directions

Procedure

- 6.** When you turn in your cards, your teacher will shuffle them well and give the shuffled cards to another lab group. You will receive a shuffled deck of direction cards made by another group.
- 7.** Devise a plan to use the directions on the cards you have been given to find the object chosen by the other group, then attempt to find the object.
- 8.** When you find the object, go back through the cards to make sure you have correctly identified the object selected by the other group.
- 9.** When you are sure that you have found the correct object, report your results to your teacher. Your teacher will confirm whether you have correctly identified the object. If not, review the cards and try again.

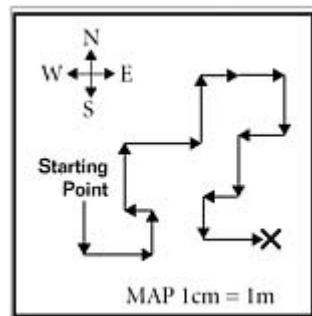
Analysis

- F.** Did shuffling the deck make it more difficult for you to locate the object? Explain why or why not.
- G.** Would you be able to place the cards in their original order? Explain why or why not.
- H.** Did you find the object described by the other group's cards? If not, explain what happened.
- I.** Explain the method you used to find the object, and include any tricks you discovered while you were working.
- J.** Was the other group able to correctly identify the object described by your direction cards?

Mapping the course

Procedure

10. In this section of the exercise, you will use the directions on a set of 15 cards to draw a map of the path from the starting point to the object. You will generate a map of the complete set of directions you used to find the object.
11. You will make the map by drawing each direction indicated on a card as an arrow. The arrow will be drawn to scale to represent the length in meters and it will point in the direction specified on the card. In a scale drawing such as this, it is important for all the objects in the drawing to have the same size relationship as the actual objects. For example, the arrow representing 2.0 m will be drawn twice as long as an arrow representing 1.0 m.
12. Draw the first arrow so that its tail is at the starting point, the point of the arrow is pointing in the direction specified on the card, and the length of the arrow represents the distance on the card.
13. Draw the second arrow on your map so that its tail starts at the point of the first arrow. The second arrow should also point in the direction specified by the card, and its length should represent the distance on the card.
14. Continue through the entire set of 15 cards. Draw the arrows tip-to-tail so that each arrow begins where the preceding one ends.
15. Make sure that the map is very neat. Include a legend, or key, that gives the directions and defines the scale of the map. You may wish to indicate specific landmarks, such as rooms or doors.



Analysis

- K. Does the map accurately reflect the path you took to find the object? If not, explain any differences.
- L. Explain how shuffling the cards affected the way you represented the directions from the starting point to the object. Use examples from your map to support your answer.
- M. Based on this exercise, describe the most efficient method of using the set of direction cards to locate the object. Would this work for any set of directions? Explain why or why not.